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Small-pox and Vaccination.[1]

THERE is something refreshingly interesting in the new practice of arranging for the education of our legislators by means of addresses by experts on subjects in which Parliament is concerned, and Dr. McVail's recent address may be regarded as an admirable example of good that may thus be achieved.

Small-pox has, however, more than a practical interest. Next perhaps to influenza it is a disease the epidemiology of which has more scientific interest than that of any other disease; and it is unique in being a disease in which pandemic outbreaks,—invading mankind at irregular intervals in an unexplained manner,—can be entirely and have been largely controlled by vaccination and by the public health measures which circumscribe the action of the virus of small-pox.

Small-pox furthermore is a disease which in recent years, and probably also in the past and even in the pre-vaccination period, has prevailed as two different varieties. One no physician could cure, and one no malapraxis could render fatal to the patient. Thus, in ten cities in the United States, of every 100 persons attacked by small-pox in 1922, 28·4 died, whereas in 1920 the fatality rate in the same cities was only 0·2 per cent. Evidently we are dealing in this experience with two diseases or with two definite mutations of the same disease. That the second is the right explanation is shown by the fact that vaccination protects against the mild as well as against the severe small-pox. In recent years our knowledge of the milder variety of small-pox has greatly increased. It has prevailed widely throughout America, spreading from the Southern Atlantic across to the Pacific. It has invaded Great Britain, and the recent mild outbreak of small-pox in Gloucester and the Midlands belongs to this type.

The mild character of the small-pox in unvaccinated persons in the recent outbreak has raised doubts in some minds as to the necessity for vaccination; but the following facts show the fallacy of this view. First, vaccination protects against the mild as against the severe small-pox. Secondly, there is a difference in degree of severity of attack,—on a lower grade than with the more serious type of disease,—of vaccinated and unvaccinated respectively; and thirdly, although details of current outbreaks are not yet available, it will doubtless be found that, as in the mild outbreaks of a few years ago, unvaccinated are attacked at a much earlier age than the vaccinated.

Nevertheless, if it could be certified that all subsequent outbreaks of small-pox would be of this unusual

[1] *The Fight against Disease.* Smallpox and Vaccination, by Dr. John C. McVail. An Address to Members of the House of Commons in Committee Room No. 14, July 25, 1923. The Minister of Health in the chair. (London: Macmillan and Co., Ltd.) Price 6*d*.

mild type, the necessity for vaccination would be less urgent than it now is. It might be limited to persons exposed to actual infection, or living in the neighbourhood of outbreaks. No such assurance can be given. In New York, both types of small-pox have been known to prevail at the same time. Our knowledge of the causation of variations in type of disease and of the correlative changes in virulence of virus and in fatality of attack is almost nil; and in practice we must be guided by the experience of the past, which shows that Great Britain is liable to be invaded at intervals not only with a relatively innocent type of small-pox coming from the west, but also with a virulent type, hailing from Asia and Africa. We cannot afford to relax our sanitary precautions against both types of the disease, nor can we afford to neglect the artificial immunity against attack which vaccination affords.

Whether in the future the secrets of the origin of the milder type of small-pox will be revealed, or whether it may be practicable to isolate the virus of small-pox or of this virus as organically modified in vaccine lymph, and afford a method of vaccination on a completely scientific basis, one cannot prophesy; but meanwhile the preventive measures already in our hands must be utilised to their fullest extent, and these enable us to control with absolute certainty the epidemic course of small-pox in its intermittent raids on mankind. Of no other disease can this be said with equal certainty, except in regard to certain tropical diseases, and to such water-borne diseases as typhoid fever and cholera. In a few years we may find that the same confident statement can be made in respect of diphtheria, if parents can be educated to realise the practicability of testing their children's susceptibility to this disease by what is known as the Schick test, and to appreciate the equal practicability of securing artificial immunity by means of toxin-antitoxin.

Meanwhile we hope that Dr. McVail's pamphlet will receive wide circulation. It establishes very clearly and succinctly the propositions which it sets out to prove, namely, that small-pox is worth preventing, that it can be prevented by vaccination, that it cannot be prevented without vaccination, and that properly conducted vaccination is very safe.

A National Education Week.

THE institution of a national "Education Week" has been officially blessed by the new President of the United States in an impressive Proclamation in which, after reciting the benefits of education, especially adult education, Mr. Coolidge declares an annual observance of Education Week to be desirable "in order that the people may think on these things." He proclaims the week beginning November 18 as the Education Week for 1923, and recommends that State and local authorities co-operate with the civic and religious bodies to secure its most general and helpful observance.

Last year, President Harding and 42 State Governors issued proclamations or statements on the subject, and the week was said to have been a gigantic success. It was estimated that the campaign reached 50 million people, including 20 million in motion-picture houses. It is probably due largely to the enthusiasm aroused by these annual campaigns that the membership of "parent-teacher" associations increased in two years from 189,000 to 500,000. Reciprocally the associations contribute enormously to the success of the Education Weeks. Without some such machinery the effervescence of the Education Week might subside without leaving any permanent beneficial results. The efficacy of this kind of propaganda depends partly on the interest already taken by the general public in education and partly on their suggestibility, and what Americans call "the magic of 'together'."

In England a notable success was achieved last year by the West Ham Education Week. This year local weeks have been organised in Nottingham, Hastings, Warrington, and Gillingham, and probably elsewhere. Should an attempt be made to organise such observances on a national scale in England, experience gained in organising the National Health Weeks initiated in 1913 by the Agenda Club might afford useful precedents. The striking success of the Education Exhibitions organised in London in connexion with the Imperial Education Conference last July by the Board of Education and the London County Council's Education Committee indicates that a national Education Week, if properly managed, would appeal to a very large public. Many recent developments in the schools, such as the increased attention paid to the teaching of science, drawing, manual training, dancing and other physical training, dramatic performances, Montessori methods, the use of "educational" films, and so on, lend themselves readily to exhibitional purposes. On the other hand, there are reasons for believing that too little effort has been made to cultivate close relations between the schools and the communities they serve.

During the past twenty-five years the achievements of science have been greater than in any previous similar period of time in the history of the world, but less is done with the object of enlightening the public regarding them than in the Victorian era. A Science Week would do much to promote public appreciation of the worth of science, and among other beneficial results that might be looked for from such an enterprise is a much needed stimulation of interest in University Extension work in the field of science.

Carl von Linné.

Linnæus (afterwards Carl von Linné): the Story of his Life, adapted from the Swedish of Theodor Magnus Fries, Emeritus Professor of Botany in the University of Uppsala, and brought down to the Present Time in the Light of Recent Research. By Dr. Benjamin Daydon Jackson. Pp. xv + 416 + 8 plates. (London: H. F. and G. Witherby, 1923.) 25*s.* net.

THOSE who admire the work of Linnæus were indebted to Prof. Th. M. Fries in 1903 for a new life of his great predecessor at Uppsala. Members of the Linnean Society of London now have to thank their general secretary for an English epitome of the Swedish work.

Linnæus accounted himself "a born methodizer." His contemporaries thought so too, and this belief is entertained still, both by those who appreciate and by those who belittle what Linnæus accomplished. But while his work justifies his own estimate, that estimate does him less than justice. Linnæus failed to foresee that in one country dialectic aptitude would eventually so affect ability to grasp principles as to induce discrimination between "pure mathematics, astronomy or any branch of science which aims merely at describing, cataloguing or systematizing," and philosophic activities that afford scope for "experimental research." He could scarcely have predicted that, in another country, the tendency to see ahead would so affect ability to look around that Linnæus could no longer be considered a botanist.

The Linnæus of the "Lachesis Lapponica" was a great naturalist of uncommon judgment, with an inborn capacity for observation. The Linnæus of the "Musa Cliffortiana" had a decided capacity for physical experiment, which later tasks hindered him from exercising to the full. Linnæus regarded the improvement of natural knowledge for use as important as its improvement for discovery; in his travels as a student and his later journeys on public commission, economic and scientific questions received equal attention. His biological study revealed the defects of received classifications; his economic instinct suggested the need for reform; his philosophic interest in the "mystery of sex" supplied the means.

Linnæus found the basis of method to be the recognition of natural kinds; the practical segregation of these into sorts and strains, and their theoretical aggregation into septs and clans. These tasks may proceed either by synopsis, which involves arbitrary dichotomy, or by system, which entails considered arrangement. Synthetic in mind, Linnæus thought system, however crude, preferable to synopsis, however complete, and so improved a by-product of scientific investigation as to substitute order for chaos in the domain of Nature. Linnæus did not claim that the system he outlined on May 11, 1731, when he was only twenty-four, added to real knowledge; its purpose was to serve economic ends by rendering real knowledge usable. Those who decry and those who excuse the artificial nature of his sexual system, alike overlook what Linnæus taught. His artificial higher groups were meant to serve as substitutes for natural ones, only until the latter had all been detected. Like his precursors, Morison and Ray, Linnæus strove to decipher the real system of Nature. Extending their studies, he laid the foundation of that system, and only refrained from applying it in practice lest those who improve natural knowledge for use be thereby deprived of a thread to guide them through the maze of things. Others have followed Linnæus along the path opened up by Morison, and have devised systems as workable as the pragmatic method of Linnæus. Modern students of the "mystery of sex" are, however, at times inclined to think these "natural" systems almost as "artificial" as the Linnean "sexual system."

Until Bauhin in 1623 enumerated the plants he knew with reference to their names, it was usual for those who reproduced old descriptions to devise fresh designations. Linnæus gave stability to Bauhin's reform when, in 1753, he enumerated the names he knew with reference to the plants concerned. For Linnæus the naming of kinds was a responsibility so grave that he made the genus "a thing of dignity." The name of a sort was, for him, necessarily that of its kind combined with a differential statement, and the relationship of a specific to its generic name was that of the bell to its clapper or the clapper to its bell. The purpose of scientific nomenclature is so akin to that of heraldic achievement as to suggest that the use by Linnæus of "trivial" epithets, ancillary to yet distinct from specific names, may have been taken from the older and rigorously disciplined technology which employs "crests" as ancillary to, although independent of, "arms." While advantageous in applied study, these "trivial" terms have proved a mixed blessing in descriptive work. Linnæus was himself so immune against both the juvenile tendency to confuse means with ends, and the adult liability to care more for names than things, that he did not foresee the later retreat from philosophical positions secured by him for science. Histories of natural "families" now supplant accounts of "genera"; now, the "trivial" terms designed by him as aids in economic work are often mistaken for specific names and sometimes treated as entities apart. The efforts to stabilise nomenclature, which this abandonment of sound scientific principles has entailed, involve results so bewildering that one

fervent hope of the applied worker is the appearance of another Linnæus.

British naturalists who know what Linnæus did will welcome most the possibility now afforded them of realising what Linnæus was. Thanks to the piety of Prof. Fries, our belief in the courage of his youth and the high purpose of his whole career is more than confirmed. We learn with relief that the tales of injustice done to him were never countenanced by Linnæus, and gather with satisfaction that these acts of injustice never occurred. The story of an averted duel was evolved from the inner consciousness of a German admirer after both Linnæus and Rosén were dead. The circumstantial account of his strained relations with Browall is a fable as impossible as it is impertinent. The frigate despatched to recover his collections is a figment of English artistic fancy. If we regret the loss of the legend of the gorse on Putney Heath, we do so less because of the story than because we learn with sadness that Linnæus did not love our nation. We find compensation in this opportunity of seeing ourselves as others see us, and take comfort from the assurance that his feeling was not due to the insular reserve, not to say frigidity, which marked his reception in Great Britain in 1736. The many acts of kindness subsequently done to him by both, effaced from his memory the original misjudgment, by Miller of his capacity, by Dillenius of his aims. What Linnæus was unable either to forget or forgive was that the English should have permitted Sweden to purchase, for the paltry sum of 15*l*., the priceless West Indian collection of Dr. Patrick Browne. Looking back through the mist of years to 1758, we may perhaps pardon the generous indignation of Linnæus at English philistinism. We can at least appreciate his feelings, and if we do not share his anger, this is only because we know that the spirit he disliked is as rampant now as it was when Linnæus lived.

Fortunately, Linnæus was spared the knowledge that this spirit is not peculiar to our nation. Inwoven in the web of his scientific thought we find a silver thread of faith in Divine Providence. But, alongside this, there lay a thread of darker hue. For the guidance of his son, Linnæus noted instances, in his own experience, of "Nemesis Divina." Was the feeling aroused by English disrespect towards the collection of Browne the reflex of a subconscious dread lest like disrespect be shown towards his own? Fate ordained that the collection of Linnæus should come to England, and Sweden knows that it has been guarded here with all the respect and care that Sweden has shown towards the Jamaica collection the study of which caused Linnæus to neglect "friends, relations, house and fatherland." History, for once, can point to a case in which the contemplation of parallel injuries has increased mutual regard, and has helped to cement the ties that link two kindred and friendly nations.

Chemistry of the Metals.

(1) *A Treatise on Chemistry*. By the Rt. Hon. Sir H. E. Roscoe and C. Schorlemmer. Vol. 2: The Metals. New edition completely revised by B. Mouat Jones and others. Part 1. Pp. xv+829. Part 2. Pp. viii+831-1565. (London: Macmillan and Co., Ltd., 1923.) 50*s*. net.

(2) *Metals and Metallic Compounds*. By Ulick R. Evans. In 4 vols. Vol. 1: Introduction, Metallography, Electro-Chemistry. Pp. xii+468. 21*s*. net. Vol. 2: Metals of the "A" Groups. Pp. xi+396. 18*s*. net. Vol. 3: The Transition Elements. Pp. xii+270. 14*s*. net. Vol. 4: Metals of the "B" Groups. Pp. xii+350. 18*s*. net. (London: E. Arnold and Co., 1923.)

(1) THE last revision, in 1913, of volume ii. of Roscoe and Schorlemmer's "Treatise" carried the volume up to the largest convenient dimensions for binding. The present revision has resulted in the separation of the volume into two parts, each containing some 800 pages, as compared with nearly 1000 pages in the volume on the "Non-Metals." Once more the revision has been carried out in such a way as to preserve fully the original character of the work, and many readers would have been disappointed if any other policy had been adopted. On these lines much valuable new information has been included in the volume, which will continue to occupy an unique place in English chemical literature. It is, however, a matter of opinion how long this policy should be continued, in view of the increasing extent to which modern inorganic chemistry is being developed on physico-chemical lines. Sooner or later, it will probably be necessary to introduce equilibrium-diagrams in the text and to deal with chemical processes in which reversible actions are used on a more definite physico-chemical basis.

The revisers have been perhaps a little too careful in retaining old matter in the text. The full details which are still given of the Leblanc soda process and of the Bessemer process for steel are really of historical interest only now that the last Leblanc plant and Bessemer converter have been shut down. It is a question whether they ought to be retained as a part of the systematic teaching of chemistry merely because a generation will probably elapse before they cease to be the subject of possible questions in examinations.

The crystallographic sections of the book have been fully revised by Mr. Barker; but it is a pity that the

new illustrations are so easily distinguished from the old by the rougher way of reproduction. The spectroscopic sections have not received a similar revision, and do not therefore give a correct impression of the modern position of the subject. Thus the apparatus "best suited to ordinary chemical purposes" is still apparently that of Bunsen, and his recommendations for mapping spectra are retained. Again, modern work on spectral series will obviously occupy an important position in the next edition, but is very barely touched upon in the present issue. The descriptive chemistry is, however, as good as ever, and the new edition can be heartily commended as one of the best available books on this aspect of the science.

(2) Mr. Evans's four volumes on "Metals and Metallic Compounds" cover a few pages less than the two parts of vol. ii. of Roscoe. He has the advantage of starting *de novo* and has made free use of this liberty by developing fully the chemical points that are of special interest to a metallurgist. The book is, however, definitely a chemical rather than a metallurgical treatise, since the compounds of the metals are described as fully as the elements themselves. To one who is interested in the broader aspects of the science, it is nevertheless refreshing to find a chapter of the introduction given up to geo-chemistry. This introduction is followed by chapters on metallography and electro-chemistry, which complete the first of the four volumes.

The systematic description of the individual metals and their compounds in the remaining three volumes is very wisely based upon the long periods rather than the short periods of Mendeléef's classification. In this way the natural sequence of alkalis, alkaline earths, and earths (rare or otherwise) is preserved, while copper is grouped with the heavy metals to which it is closely allied. The "eighth group" metals occupy the third and smallest volume of the series, while the second and fourth volumes deal with the elements which occur in the earlier and later octaves of the long periods, together with their obvious homologues in the two short periods. Throughout these volumes the impression is maintained that the author is a geo-chemist and a metallurgist as well as a chemist, and that he has an up-to-date knowledge of modern technical operations as well as of pure chemical science. His references to technical and semi-technical literature are likely to prove of special value, since, although literature of this kind may be of relatively transitory importance, it is much less accessible to the ordinary chemical student than the literature of pure chemistry, to which existing text-books form a sufficient guide.

In view of its special characteristics, Mr. Evans's treatise does not enter into direct competition with any other work on chemistry, at least in the English language. It will probably appeal in a special way to chemical students with a leaning towards the practical side of the subject, to metallurgists and to engineers; but it will also serve as a work of reference by means of which chemists in general may trace out items of interest which are not noticed in books of a more conventional type. It can therefore be highly commended as an original work of more than average merit, on the prompt completion of which the author may be congratulated.

Alpine Tectonics and other Problems.

(1) *Die Grundlagen der alpinen Tektonik.* Von Fr. Heritsch. Pp. v+259. (Berlin: Gebrüder Borntraeger, 1923.) 9*s.* 6*d.*

(2) *Geologie von Württemberg nebst Hohenzollern.* Von Prof. Dr. E. Hennig. Erste Lieferung. (Handbuch der Geologie und Bodenschätze Deutschlands.) Pp. iii+216. (Berlin: Gebrüder Borntraeger, 1922.) 8*s.* 2*d.*

(3) *Grundzüge einer vergleichenden Seenkunde.* By Prof. Dr. W. Halbfass. Pp. viii+354. (Berlin: Gebrüder Borntraeger, 1923.) 15*s.* 3*d.*

(4) *Geomorphology of New Zealand.* By Prof. C. A. Cotton. Part 1. Systematic: an Introduction to the Study of Land-forms. (New Zealand Board of Science and Art, Manual No. 3.) Pp. x+462. (Wellington, N.Z.: Dominion Museum, 1922.) 22*s.* 6*d.*; paper, 18*s.*

(1) THE current theories of Alpine structure are based on two main explanations. According to one, Alpine mountains consist of bands of the crust which have been crumpled by contraction consequent on the diminishing size of the earth. According to the second explanation—the *Versluckung* or the swallowing theory of Schwinner—a band of the crust sinks into a lower zone, and there undergoes intense compression, accompanied by the metamorphism of its rocks.

Dr. F. Heritsch, of Graz, discusses these two hypotheses in a masterly survey of the principles of Alpine geology. He deals mainly with the Eastern Alps. The treatment is very technical and would be easier to follow if illustrated by a general sketch map. The first part of the book consists of a series of essays on the principles of rock folding; he therein discusses the nature of geosynclines, of local and widespread movements of the crust, and the formation of fore-deeps. In his account of the widespread or epeirogenetic movements he lays stress on the oscillation which often accompanies variations in coast levels. He then discusses the phenomena of folding, overfolding

and overthrusting; he deals mainly with observed examples, as he regrets that tendency to consider folding from general principles which has often led to a geometrical rather than a geological treatment of the problems. He next deals with the behaviour of rocks under pressure and gives an excellent account of dynamometamorphism, mylonitisation, and the plasticity of rocks.

The largest part of the book consists of an account of the structure of the Alps in which the author insists on the "impossibility" of the overthrust theory in its present dominant form. He supports the "swallowing theory" which represents the crust of the earth as being under conditions analogous to those of the atmosphere. In certain areas, which correspond to the anticyclones, the movement of the material is upward, leading to the formation of volcanoes and the rupturing of the crust. In other areas, which correspond to cyclones, the crust moves downward, producing fold mountain chains owing to the lateral pressure, and also widespread metamorphism. Overthrusting inevitably takes place in the subsiding area, but the thrusts have a more limited horizontal extension than is claimed by the upholders of the *Deckentheorie*, which in its extreme form Dr. Heritsch describes as mere phantasy. The swallowing theory is, however, not inconsistent with the general contraction of the earth. It in fact renders that process more probable by rejecting the immense horizontal overthrusts which are too great for contraction alone to explain. The deformation of the earth by contraction indeed supplies the power which is required for regional uplifts and causes the subsidence of the intensely crumpled bands which have formed the fold mountain chains at different places at successive periods in the earth's history.

Dr. Heritsch's book is an able and sane statement on a complex branch of geology. It should be a useful corrective to the exaggerations of one school of Alpine geologists.

(2) North of the Alps lies the province of Württemberg, which has been affected by some of the Alpine movements but presents a marked contrast by its comparatively simple though varied geology. The province has played an important part in the history of geology. Tübingen has been one of the great geological schools of Germany, and, as Dr. Hennig reminds us, both Kilima Njaro and Kenya were discovered by men of Württemberg, though they were both at the time in the service of a British Missionary Society. The richness of Württemberg in fossils made it one of the chief centres of German palæontology, and the museums of Tübingen and Stuttgart are so rich in types that they have attracted generations of geological pilgrims. The province includes one of the most typical series of Jurassic rocks, an illuminating group of pygmy volcanoes and structures throwing light on the physical and glacial geography of the northern Alps.

The comprehensive summary of the geology of Württemberg prepared by Prof. Hennig, of Tübingen, is therefore welcome, as it gives an up-to-date summary of the German Jurassic system and a guide to the localities made famous by the work of Quenstedt. The first part has been issued, and it deals with the orography and with the stratigraphy up to the end of the Jurassic. The two sections of this part which will be of widest interest are the account of the Trias with its rich development of the Muschelkalk and of the Suabian Jurassics, which include the rich coral reefs for which the locality of Natheim has been especially famous.

The book is illustrated by two excellent coloured maps, one of the orography and one of the geology of Württemberg, by many clear diagrams of the palæogeography and lateral variations of the rocks, and a correlation of the English and German Jurassic deposits. In the author's classification of valleys, p. 7, he uses the term "isoclinal valley" for those in which the dip is the same on both banks owing to the valley having been cut in an inclined sheet of rock. This term is so likely to be confused with an isoclinal in which the equal dip on both sides of the axis is due to overfolding, that it is to be hoped that the new usage will not be generally adopted; for such valleys either the terms uniclinal or homoclinal are available.

(3) Forel's "Handbuch der Seenkunde," the standard text-book on the physical geography of lakes, was published in 1901, so that a new work was desirable, and the previous writings of Prof. Halbfass, of Jena, have shown, by his wide knowledge of the scattered literature on the subject, that he is especially competent for its preparation. His book is based on the principle that the essential feature of a lake is its water and not its basin. Hence a larger part of the volume is devoted to the physics and chemistry of lakes than to the nature of their basins. He discusses the movements of lake waters due to thermal changes, and to seiches, and variations of the shore lines caused by the tilting of the crust. There are short chapters on the optical and acoustical properties of lakes, including in the latter the "Barisal guns," which appear, however, to be due to seismic influences on delta deposits and to have no connexion with lakes. The mirage effects in some Hungarian lakes are illustrated graphically by a series of views taken at intervals during the day. There is an especially useful summary of the chemistry of lake waters. The chapter on the biology consists of only two pages; it considers the relations of some animals living in deep lakes and accepts them as

survivals from a cold-water fauna which had a wide-spread distribution at the end of the glacial period.

In dealing with the variations of lake levels, Prof. Halbfass discusses the asserted dessication of the continents. This view he dismisses most emphatically. The fall in level of many lakes he attributes to artificial influences, and he holds that lakes in all parts of the world show that there has been no general lowering of their level in historic times. He refers especially to Lake Chad, which he says is placed in the first line by the "dessication fanatics." He holds that this lake gives them no support since Marquardsen has shown that for eighty years after the visit of Denham (*i.e.* from 1824 to 1905), the boundary of the lake has remained essentially the same. In dealing with this problem he refers to Bruckner's thirty-five-year climatic cycle period, which he says is not confirmed by the evidence of the lakes of at least four of the continents; yet he holds that there is an actual climatic period, which is three times as long as the Bruckner period.

In the chapters on the distribution and origin of lake basins Prof. Halbfass rejects their glacial origin, except in so far as many of them occupy hollows in drift, or are held up by moraine dams. He rejects not only the glacial origin of deep rock basins but of many lakes of the Baltic Plain for which glacial denudation seemed far more probable. He adopts the views of Wahnschaffe and Jentzsch that these basins are due to tectonic subsidences, and in some cases, such as that of the Rogasener Lake in Posen, the basin, though now all covered with drift deposits, was pre-glacial in origin. In dealing with this problem Prof. Cotton's book (4), which is a general summary of physiography illustrated by examples from New Zealand, is less in accordance with recent opinion; for he represents the New Zealand fiords as glacially cut troughs of which the lower parts have been filled by the sea. They appear to agree with those of Norway, where the overwhelming balance of opinion is in favour of the pre-glacial age of the fiords. Prof. Cotton has an exceptionally fascinating subject, as New Zealand is especially rich in clear examples of geographical processes.

The book is well illustrated and his views are clearly stated. It illustrates the growing extent to which some schools in Australasia are dominated by American opinion; this fact, in the case of geography, is easily explained by the attraction of that logical scheme of geographical evolution for which we are deeply indebted to Prof. W. M. Davies. The extent to which British work is overlooked may be judged by the bibliography. Of the 59 memoirs quoted only five are British, and they date from 1802 to 1876, the latest contribution in this list by any British worker being Thomson's paper on the windings of rivers.

Our Bookshelf.

Theorie der Kristallstruktur: ein Lehrbuch. Von Prof. Dr. Artur Schoenflies. Pp. xii+555. (Berlin: Gebrüder Borntraeger, 1923.) 18*s*.

APART from its obvious indispensability to the specialist, this new edition of the author's former "Krystall-systeme und Krystallstruktur" (1891) would seem to bear a character of wider significance, as showing that wisdom is justified of her children. There can be few such signal instances in science in which an abstract and apparently unverifiable theory has been so rapidly brought within the ambit of the experimental method, and proved to be equal to all demands. It is, therefore, peculiarly appropriate that one of the original founders of the modern theory of crystal structure should return to his subject in the light of recent X-ray developments. By including a discussion of those points in which the theory is still ahead of experiment, the author contrives to confer on his work a new prospective value.

The book is, of course, mainly concerned with a systematic development of the 32 classes of symmetry and the 230 possible ways in which matter may be properly disposed throughout the space occupied by a crystal. The general arrangement is necessarily much the same as before, but the exposition has been vastly improved in at least one particular. The former edition was solely addressed to the mathematician, to whom the addition of anything of the nature of a diagram (unless it take the special form of a symbol) would presumably impede the working of pure thought. The present work is rather directed to the crystallographer and X-ray analyst, and is therefore illustrated with structural diagrams, praiseworthy alike in quality and quantity.

In view of the existence of such an authoritative treatise as the Braggs' "X-rays and Crystal Structure," the author has refrained from entering into any account of the practice of X-ray investigation. It is, however, evident that the actual results are fully appreciated, for considerable space is devoted throughout the text to a systematic treatment of the relations between the number of particles (as also their symmetry) and the various positions they occupy in the structure. Moreover, a special chapter is devoted to space-partitioning and the packing of equal spheres; whilst another, possibly the most important of all, deals with selected cases investigated by X-ray workers. This inevitably leads to a discussion of the possible influence sub-atomic structure may exert on the physical manifestations of a crystal, and to a final conclusion that the only possible way of further progress is along the path of experiment.

It may be added, in conclusion, that those qualities of clear and concise expression, which have always made Dr. Schoenflies' writings the most favoured original source in the domain of crystal structure, are fully preserved. By bringing out so valuable a work in the face of obvious contemporary difficulties, both author and publishers have placed a wide-spread body of workers under a debt of gratitude, which they can scarcely ever discharge.

T. V. B.

The New Natural History: Being the Twenty-Fifth Robert Boyle Lecture delivered before the Junior Scientific Club of the University of Oxford on 6th June, 1923. By Prof. J. Arthur Thomson. Pp. 19. (London: Oxford University Press, 1923.) 1*s.* net.

IN this refreshing and stimulating address Prof. J. Arthur Thomson pleads for the retention of the term natural history as a designation for the study of the habits and surroundings of animals and their inter-relations with one another—the new natural history—and for its more honourable recognition as a well-defined and integral department of biological science.

Out of the ashes of the old all-embracing science of natural history, the author traces the growth of the new science under the influence of various factors which have moulded its development. Chief among these is the recognition and appreciation of the great fact of the inter-relations of living organisms in the web of life and the external linkages between animals or animals and plants—the central Darwinian idea of the correlation of organisms. This has given direction and stimulus to the study of natural history and forms one of the guiding principles of the new science. No less important is the new and more precise scientific outlook on the question of animal behaviour, due to the work of Lord Avebury, Romanes, and especially Lloyd Morgan, who laid the firm foundations of an experimental comparative psychology, and to Loeb, who has done so much to develop the question on the physiological side. From the somewhat chaotic mixture of anthropomorphism and automatism there has emerged a precise science that distinguishes instinctive from intelligent behaviour and both from tropisms and forced movements.

A third factor which has given precision to the observations of the field naturalist and a new significance to his facts is the idea of evolution. With this as a working hypothesis the student of natural history has been stimulated to discover how a particular structure or function is fitted to a particular situation, and the study of adaptations has developed into an important and exact science.

The vision of the new natural history as a study of "animal personalities at various levels, as creatures with mental aspects, as agents that seek after well-being and share in their own further evolution, as threads in a quivering web of life" is indeed an inspiring one. Prof. Thomson justifies his plea, and the recognition which he asks for cannot be long withheld.

Alternating Current Electrical Engineering. By W. T. Maccall. Pp. viii+493. (London: University Tutorial Press, Ltd., 1923.) 15*s.*

A FAIRLY complete résumé of practical alternating current theory is given in this work. In order to keep the subject matter within the limits of one volume the explanations have to be made very concise. It is therefore more suitable as a class book than for reading by the private student. It covers a very wide field. The theory is now beginning to crystallise, and so numerical examples have been introduced which will enable the student to test the thoroughness of his knowledge.

The book is on the whole well written. The author sometimes gives results as if they obviously followed from the given premisses; for example, in describing how two induction motors are connected in cascade, he says that the supply mains are connected to the stator of one motor and its rotor is used to supply power to the second stator. "The result is that the synchronous speed of the combination is that of a motor whose number of poles is equal to the sum of the number of poles of the two motors." This is a hard saying, and we hope few readers will accept it without trying to make up some proof for themselves. If the author made the distinction between "average power" and "instantaneous power" clearer the proofs of the two and three wattmeter methods would be greatly improved. At the foot of page 61 a reference is made to the instantaneous value of the average power. A vector proof is given of the three-voltmeter method of measuring power, and it is stated that it should not be used unless the wave forms are nearly sine shaped. The ordinary algebraical proof shows at once that it is true, however distorted the wave forms may be. The Behrend definition of the leakage factor of an induction motor is given, and one of the methods described of determining its value is by Behn-Eschenburg's formula, which applies to a totally different definition of leakage factor.

Popular Fallacies Explained and Corrected (with Copious References to Authorities). By A. S. E. Ackermann. Third edition. Pp. xvi+984. (London: The Old Westminster Press, 1923.) 12*s.* 6*d.* net.

To every one who has made a special study of any particular branch of human knowledge there must, at some time or another, have come a feeling of surprise at the large number of errors which exist in the popular mind regarding his own, and therefore presumably every other, subject. The previous editions of this book have proved of immense value in helping to correct the many errors which still persist in spite of the progress of popular education and the many devices now used for the dissemination of accurate information. A very real welcome is, therefore, assured for this, the third edition, which has been so extended in scope that it has become almost a new work. The number of fallacies dealt with has been increased from 460 to 1350, and these cover practically every branch of human activity. Indeed, so wide is the field covered, that a reviewer may be pardoned for paying particular attention to those sections by which he may expect to be best able to judge of the value of the whole. Engineering, general science, and astronomy receive their full share of attention at the author's hands—as might, indeed, be expected from one whose qualifications lie particularly in the first-named subject—and a close perusal of these sections has abundantly demonstrated the painstaking accuracy of the author's work. As Sir Richard Gregory points out in an appreciative introduction, a valuable feature of the book is the constructive work which it does in giving the truth of any matter concerning which an error is exposed. In conclusion it should be mentioned that the book is written in an eminently readable style, not unenlivened with touches of genuine humour. It is, moreover, well printed and may be cordially recommended as a useful addition to the library of general knowledge.

Heat and Energy. By D. R. Pye. (Clarendon Science Series.) Pp. xii+211. (Oxford: Clarendon Press; London: Oxford University Press, 1923.) 5*s.* net.

As stated in the preface, this book is not designed to be a text-book in the ordinary sense of the word. It is intended to be read by the advanced schoolboy to supplement the detailed instruction he has received in the class-room and the laboratory, with the view of imparting a broader conception of energy in its different forms. The first six chapters are devoted to heat, the chief phenomena being described and explained with less detail than is customary in the ordinary text-book. The relation between heat and work is then dealt with, followed by chapters on energy as light and sound. The remaining part of the book is taken up with practical applications of energy in the production of power, warming, ventilation, and refrigeration, the principles involved being clearly explained.

On these lines the author has produced a very readable volume, but it is difficult to see why he fails to give an account of electricity as a form of energy, as in these days almost every boy is interested in electricity through the medium of "wireless." A further addition, in the form of a few pages on the measurement of high temperatures, might be recommended, not only because of the practical importance of the subject, but also for the interest it creates in the mind of the young student of science. Apart from these omissions, however, there is no doubt that the careful reading of this book by an intelligent schoolboy would give him a much wider outlook than that provided by the ordinary text-book. C. R. D.

The Dance of Life. By Havelock Ellis. Pp. xiv+340. (London, Bombay and Sydney: Constable and Co., Ltd., 1923.) 12*s.* net.

THE main contention in "The Dance of Life" is that life is an art, as its expressions in morals and religion (which the author calls "mysticism"), in writing and thinking, and even in science, are arts, appropriately typified by the art of dancing. Life, in all its forms, is creative, the result of an impulsive outflowing. Accordingly, rigid laws, externally imposed, are really inapplicable to it. The dynamic is refractory to regulation by the static. What law there is must needs be from within; the formulation of the impulse of which it is the law. Mr. Havelock Ellis is not the only prophet of this doctrine in recent times; and, indeed, its underlying thought is a very old one indeed—a thought never quite forgotten even when the dynamic movements of reality were caught and crystallised in the static formulæ of philosophy and science. But it is none the less, when stated in isolation, a paradoxical view; and not least so when it is applied to a solution of the social problems of the present day. Yet "The Dance of Life" is a very stimulating and, indeed, challenging book, in itself a work of no mean art. Though in appearance roughly flung together, its several chapters have a single thread of thought—the view to which allusion has been made—running through them all. Philosophers of many schools and men of science alike may find much to disagree with in this book; but none can read it without interest, and few without some profit.

The Subject Index to Periodicals, 1920. Issued by the Library Association. F: *Education and Child Welfare.* Pp. 29. (London: Grafton and Co., 1923.) 4*s.* net.

THE Library Association maintains in this section of its Subject Index the high standard of quality of the earlier issues, but when one compares it with the American "Readers' Guide," the 1919–21 volume of which was published last year, one cannot but regret that the English Index is so deeply in arrear. It is true that it gleans over a much wider field, but it is questionable whether it would not be better to speed up the work even though this should necessitate some restriction of the sphere of operations. In this Education and Child Welfare section, professional and technical education, mental tests, the teaching of citizenship, languages (especially Latin), economics, geography, mathematics, and religious education all figure largely.

The articles indexed under science teaching are chiefly from the *School Science Review* and *Parents' Review*, but include some from the *Revue Pédagogique*, *Science Monthly*, and NATURE. The quarterly *Educational Record* published by the American Council on Education does not appear to be included within the scope of the work. It contained in 1920 important articles by President A. T. Hadley, Prof. G. D. Strayer, Dr. S. P. Capen, and other well-known authorities, which might with advantage have been mentioned in the Index.

Outlines of the Calculus for Science and Engineering Students. By Dr. Terry Thomas. Pp. 127. (London: Mills and Boon, Ltd., 1922.) 3*s.* 6*d.* net.

MANY students will find Dr. Terry Thomas's latest book of considerable value, not for private study of the subject, but also for use with oral lessons and for revision purposes. Although Dr. Thomas's brevity is a welcome change from the prolixity of some recent mathematical text-books, it is yet too pronounced a feature in the present volume, reducing the subject-matter almost to the tabloid form. The course is nevertheless a very suitable one and the examples are well chosen.

One or two criticisms of detail may perhaps be useful to the author if a second edition is called for. The "don't" of p. 10 is transgressed by the author himself on pp. 34, 75, etc. Students should be taught to distinguish between ordinary and partial differentiation as regards symbolism: it saves a good deal of trouble. The example chosen on p. 80 to show the "impossibility" of separating x and y is rather unfortunate. S. B.

Supplementary Notes on Gravimetric Analysis for Beginners. By W. Lowson. Pp. vi+58. (London: Longmans, Green and Co., 1923.) 2*s.* 6*d.*

THESE notes are intended to be used in conjunction with regular text-books. There are many valuable hints on practical details, and items of theory which are not easily found by students. The book will be found useful by those beginning quantitative analysis (the calibration of volumetric apparatus is included), and its moderate price will commend itself to students.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Polarisation of Double Bonds.

IN the September number of the *Philosophical Magazine* Sir Joseph Thomson has applied the theory of electrostatic induction to explain the mechanism of polarisation of double bonds and of the orientation of substituents in the benzene series.

Electrostatic induction is what we have imagined to be responsible for the "general" electrical effect of a substituent by producing a kind of drift of electrons in the molecule as shown in the scheme

$$Cl - + (C)_1 - + (C)_2 - + (C)_3 - + (C)_4 - + (H)$$

and we have attributed the superposed alternating polar effect to other causes, and predominantly to the laws of valency in their application to polarised complexes. In such a system as that depicted above, Sir Joseph Thomson suggests (p. 511) that as the result of the existence of the electrostatic doublet between Cl and C_1, electrons will crowd into C_1 from C_2, and into C_3 from C_4, and thus an alternating condition will be brought about in the chain. But for the same reason that electrons pass from C_2 into C_1, it would seem to us that electrons should also pass from C_3 into C_2, and the effect would then be continuous although diminishing in degree along the chain. The precise manner in which the difficulty is overcome is not quite clear, but we gather that Sir Joseph Thomson holds that electrons may pass from one carbon atom to another, if these are joined by a double bond, but not if they are joined by a single bond, which view would require the acceptance of the Kekulé benzene formula in its simplest form, and would be contrary to all the indications of modern researches on the conjugation of ethylenic groups and on intra-annular tautomerism.

A much more obvious, though not more serious, objection to Sir Joseph Thomson's method of deduction of the alternate effect is that while it leads to the right result in fifty per cent. of the cases, it leads to the wrong result in the remaining fifty per cent. For example, the direction of polarisation of the double bond in vinyl chloride, the example which Sir Joseph Thomson himself selects, is just the opposite of what experiment indicates. Thus, he provides the carbon atom which is attached to the chlorine with a greater density of electrons than the other, as indicated by the symbol $CH_2 \cdots CH \cdot Cl$, where the lower dotted line represents, say x electrons, and the other represents $2 - x$ electrons, the whole symbol thus indicating an augmented electronic density on that side of the double bond which is nearest the chlorine atom and a decreased density on the other carbon atom.

Now, it is easy to see that this process tends to produce a positive charge on the CH_2 carbon and a negative charge elsewhere, and consequently the carbon atom of the CH_2 group should, if anything, attract negative ions, and the product of the action of hydrogen chloride on vinyl chloride ought to be ethylene dichloride $CH_2Cl - CH_2Cl$. But, as Sir Joseph Thomson correctly states on p. 508, it is the carbon atom to which halogen is attached in a substituted ethylene which attracts negative ions. Were it proposed to escape this dilemma by assuming that the atom with the diminished density of electrons is the one which is ultimately found attached to the positive ion or radicle of the reactant, then further difficulties emerge and, for example, in the group $C_3 = C_2 - \overleftarrow{C_1 = O}$, it would be necessary to postulate a passage of electrons in the direction indicated by the arrow in order to reconcile Sir Joseph Thomson's theory of the mechanism of induction with the experimental fact that invariably C_3 is the atom which is found attached to the negative radicle or ion of the reactant. Without going into detail it is obvious that similar considerations apply to orientation in the benzene series.

Finally, the classification of atoms as "chemically active" or "chemically inert," according as there is a defect or excess of electrons respectively, is unsatisfactory, since both types appear to be reactive under the correct conditions. Charged centres in polarised molecules are analogous to charged ions and it is difficult to see why the comparison should not be extended to their reactions.

A. LAPWORTH.
R. ROBINSON.

The University, Manchester.

River Pollution.

THE Salmon and Freshwater Fisheries Act, 1923, will come into operation on January 1 next, replacing the many Acts, beginning with that of 1861, which have been framed to regulate the fisheries of our inland waters. The first of the series contained a clause relating to the pollution of rivers, and this clause has up to now been practically the only statutory control we have had. It was reinforced by the River Pollution Prevention Acts, and this legislation was sufficient to prevent sewage being poured in an untreated state into rivers, but not into estuaries, and it proved ineffective in preventing poisonous effluents from industrial concerns contaminating both.

The new Act defines rather better the nature of the pollution which will be regarded as an offence (Section 8), empowers fishery boards to institute proceedings under the River Pollution Prevention Acts, 1876 to 1893 (Section 55), and provides (Section 73) for cases being tried before the nearest court of summary jurisdiction.

The rivers in the meantime have been allowed to get into a serious state of deterioration, due to the great developments of population and of industries. Our legislation hitherto has prevented any undue contamination by sewage of the non-estuarine parts of the rivers. It was really strong enough to prevent pollution by effluents from commercial works. But the dominance and importance of the industries have been usually overpowering, with the result that many of our rivers and streams have been allowed to get so severely polluted that they are almost, or altogether, devoid of life. The estuaries, with the growth of industries and of towns and cities, have been exposed to pollution from trade effluents to a greater extent than the river, and have had to carry a steadily growing burden of sewage. The result, as is well known, is that some estuaries are so badly polluted as to prevent the passage of migratory fish, and many others have got near the same state. With the advent of the new Act we have inherited an interesting and important problem, a problem which, like previous legislation, is a product of the industrial growth of the Victorian period.

Already some progress has been made by experiment and inquiry to state more distinctly the problem and the solution. The Ministry of Agriculture and Fisheries has shown its sympathy and its appreciation of the condition of the freshwater fisheries by appointing a Standing Committee on Rivers Pollution, and

by instituting Sub-Committees for some of the important watersheds. But it is difficult to understand the attitude of the Ministry of Health and of medical officers. At two recent inquiries relating to new sewers which were designed to discharge sewage untreated into an estuary, the representative of the Ministry of Health admitted that the estuary was already overcharged with sewage, but said that the new sewers would not alter that aspect of the question, that the estuary was so bad now that it would by this addition be very little the worse.

The medical officer goes further. He says the deaths of the fish in the estuary are caused entirely by trade effluents, and that we should get more powers to deal with such pollution. As for the sewage, he will tell you that no matter how great the quantity it is not unhealthy, it is not in any way related to the destruction of fish, and he will produce statistics to show that the healthiest parts of the county and the city are just where the sewage contamination is heaviest.

Without attempting at present to deny the truth of his extraordinary statements or presuming to explain the reason for his making them, it ought to be pointed out that, even if he is right, he is arguing that it is not necessary in any case to treat sewage, and therefore that authorities everywhere should be freed from the necessity and the expense of doing so. Indeed, we should not lose sight of the fact that if the killing of the fish in the river from whatever cause proceeds to the phase of practical extermination, an important and essential feature of the river will come to an end, nor of the probability that the authorities throughout the watershed will object to being subjected to an expense no longer necessary. The river in such a case would be converted into a sewer, a condition which is already met with in some of our estuaries and rivers. The river boards, on the other hand, are desirous to preserve the rivers as rivers, and to save them from becoming sewers.

The experiments which have been made with reference to the estuary of the Tyne have demonstrated plainly (1) that it is over-polluted with sewage; (2) that it is frequently little better in composition than the liquid outflowing from the sewers; (3) that the sewage in the region opposite Newcastle is the cause of a serious diminution in the quantity of dissolved oxygen; (4) that the oxygen frequently descends below the limit necessary to sustain fish life, and is only restored by freshets from the river; (5) that in consequence, during dry weather conditions, many deaths occur, either by direct poisoning or by the lack of oxygen. It has been proved by experiment, moreover, that the sewage alone will cause death, and that it may be directly poisonous to fish.

It is obvious, therefore, that in the case of the Tyne and of many other rivers of our country, both the river and the estuary will have to be cleaned. In the case of the river, trade effluents will have to be treated to prevent any poisonous effects. The estuary is far more important, for at present it is liable to provide an impassable barrier to fish. The solution of the problem is not an easy one, but it will have to be faced some time, and, we hope, before the barrier becomes so great that migratory fish will have ceased to enter the river.

Even with the powers conferred by the new Act, little will be accomplished unless with the sympathetic co-operation of the authorities and the owners of works. Already they have shown a strong disposition to help in the inquiries and in taking steps to minimise the effects of the effluents. As soon as it is clearly realised by all concerned that action is necessary, it will not be so difficult to indicate in what direction it should proceed. A. MEEK.

The "J" Phenomena and X-ray Scattering.

IN a number of recent papers, Prof. A. H. Compton brings forward what purports to be a Quantum Theory of the scattering of X-rays. I venture to think that this theory—or more correctly system of rules—has little connexion with the phenomena of X-ray scattering as I observed it nearly twenty years ago, and as I still know it. I do not wish to write of the inconsistency or illogicality of the theoretical assumptions, for they are probably as well known to Prof. Compton as to the most careful reader. Prof. Compton seems to hope that, in spite of this, the truth will emerge. But I am compelled to state a few significant facts which are not common knowledge.

Regarding the experimental observations establishing a difference between the primary and the secondary radiations *observed* (assumed by him to be scattered radiations), I should like to point out that they date from the earliest experiments on the subject (see Sagnac; Barkla, *Phil. Mag.*, 1904; Beatty; before those to which he refers). It is very easy to detect differences in the penetrating powers between the primary and secondary (scattered) X-radiations as ordinarily measured.

The greatest difficulty has been experienced by experimenters, not in establishing a difference between the primary and secondary radiations, but in showing that they are at all similar. They have not always realised the conditions essential for this. The necessity of using soft X-radiations in order to obtain evidence of the purest scattering and the almost perfect agreement with the classical Thomson theory, I have emphasised again and again. There have been various reasons for this, some obvious, others long since observed but only recently studied. The superposed radiation excited in the scattering substance by the swift electrons constituting the secondary corpuscular radiation and the possible emission of further unknown fluorescent X-radiations are among the obvious. For many years now I have known of a further and more important source of error; this is connected with what I have called the "J" radiations, discontinuities, or transformations. The important fact, whatever its explanation, is that a beam of X-rays in transmission through matter under certain critical conditions becomes considerably more absorbable both in that and other substances. We have made scores of experiments of various kinds on this abrupt transformation; more will be said of it elsewhere. What concerns us at present is that this is of such a magnitude as would be accounted for by an absorption and re-emission of the radiation with an increased wave-length of the magnitude required by Compton—about 0·02 Å.U. But this is in the direction of propagation of the primary beam; and experiments do not seem to support this view as to the nature of the change. Absorption in this region evidently depends upon factors other than wave-length and atomic number. This is the J discontinuity which I mentioned in 1916 (Bakerian lecture) and again with Miss White in 1917 (*Phil. Mag.*, Oct. 1917).

We can now certainly say that these J transformations not only *might* produce, but actually *do* produce the softening which *we* have observed in the scattered radiation in many experiments at any rate. It is not unreasonable to suppose that it is the explanation of the changes observed by others, not only in the region of wave-lengths over which we can make a definite test, but also over the range of shorter wave-lengths, over which we are not at present able to get control.

It is impossible in the space now at my disposal to give full evidence for this; but the only rational conclusion is, that this transformation observed is not in the process of scattering but in the subsequent

transmission of the scattered radiation through the radiating substance and through the absorbers.

Prof. Compton apparently did not read between the lines of a communication to the *Philosophical Magazine* (Barkla and Mrs. Sale, April 1923); but as the results do not suit his formula he makes a suggestion of how such results might have been obtained by very incompetent experimenters. May I now suggest to Prof. Compton that, in addition to taking other very obvious precautions, he might also use soft radiations, very thin radiators, and very thin absorbers. I do not think he will then have much difficulty in obtaining scattered radiation very like the primary and very different from what would be given by his formula.

Regarding the transformations of radiations of shorter wave-length, I will only say that it is much more difficult to obtain anything like equality of penetrating power between primary and scattered as usually detected; but an explanation of this can be given,—not the ultimate explanation, but again in terms of the J transformations.

Further, let us examine the theory of the recoiling electrons. Giving the Compton formula the best chance of success, consider what would happen to the electrons in hydrogen which require little energy for their extraction. These electrons scatter as much as a similar number in other substances (Barkla and Crowther). A simple calculation shows that when the K radiation of tin is employed, the recoil electron should produce an ionisation of the order of 1/100th part of that produced in air by the same X-radiations through the ordinary long-range electrons. Now Shearer in this laboratory observed in hydrogen an ionisation as low as 0·0016 of the ionisation in air; and remarked on the strong probability of this being an over-estimate. This would be of the right order of magnitude for the effect of long-range electrons alone. Where then is the effect of ionisation by Compton's scattering electrons? It apparently does not exist.

The evidence Compton used and obtained from the study of γ-rays is necessarily much less trustworthy; the experimenters have probably never—indeed cannot have—realised the many possibilities of error. Any transformation to a softer type—or at any rate something equivalent to that—would entirely vitiate the results obtained both in absorption and scattering experiments. Without wishing to detract from the merit of the work, one may justifiably point out the difficulties of exact measurement in this region. One is led to ask: Are experiments on the diminution of scattering really trustworthy? Accurate they cannot be; they may be entirely misleading. Thus in cases we have investigated, Compton's formula holds neither for the apparent change of wave-length, nor for the energy of the recoil electrons. But we can quite easily get many of the effects of the kind Compton considers.

It is possible that the J transformation which we have observed will be explained by a theory bearing some resemblance to that of Compton for so-called scattering. This would be supported by the evidence of C. T. R. Wilson's "fish-tracks." It seems unfortunate that Prof. Compton should have applied the term scattering to a hypothetical process which is so essentially different from the scattering of X-rays as ordinarily known. The important conclusion is this—the results of experiments on scattering and the Thomson theory explaining these are absolutely untouched.

Many of the experiments upon which these conclusions have been based were obtained in collaboration with Mr. Khastgir and Mr. Stevens, in addition to those already mentioned.

C. G. BARKLA.

University of Edinburgh.

November 10, 1923.

Scientific Names of Greek Derivation.

I AM glad that Sir Clifford Allbutt, in NATURE for October 20, p. 590, supports the spelling "deinosaur," although Owen wrote Dinosauria. Only a week ago I heard a university student pronounce the word as "dinnosaur." Wherever pronunciation can be helped by correcting current forms the correction is obviously of service. From this point of view we may pardon, even if we regret, Miocene and Pliocene. No one, however, has attempted to write "Plistocene." We have for some centuries converted the Latin forms *ae* and *oe* (for the Greek *ai* and *oi*) into the forms æ and œ in manuscript and in print; but this has no classical authority and can be abandoned with much advantage, as has been done in modern Latin texts. The Greek diphthong or semi-diphthong *ei* could not well be shortened into one letter in our script, and this fact provides an inconsistency for those who join *a* and *o* to *e* in transliterations from Greek or Latin. Where the word has become anglicised in form, as cœnosarc, or where, like cœnenchyma, it is not a generic or specific name, the diphthong no doubt will remain compounded; but we may, I think with wisdom, write Coeloptychium and Taenia. Moeritherium is a case that needs attention. The British Museum, which has an honourable vested interest in the mortal remains of this fascinating creature, writes the *o* and the *e* separately. The Americans, and now the Japanese, adopt the compounded form.

Dr. L. C. Purser, to whom I confide all my classical troubles, tells me that Herodotus (Book II., 148) gives the lake in the Fayūm as ἡ λίμνη ἡ Μοίριος, named from a king who would appear in Latin as Moeris. C. Stephanus ("Dictionarium historicum," A.D. 1633) prints "Mœridis stagnum"; but here again the separation of the *o* and *e* would seem advisable. I confess that I always write Cainozoic in preference to Caenozoic or Cænozoic, though the æ conforms best with our general usage. This term, however, never had a Latin form, and may now be regarded as an English word.

As I remarked in my note in NATURE for July 7 (p. 10), it is now difficult to be logical. The Encyclopædia Britannica gives us an article on Deinotherium, but makes us look under *di* for deinosaurs. Following Sir Clifford Allbutt, let us help pronouncers—and printers—where we can.

GRENVILLE A. J. COLE.

Carrickmines, Co. Dublin, October 28.

Is the Pentose of the Nucleotides formed under the Action of Insulin?

IN a letter to NATURE for June 16, p. 810, Messrs. Winter and Smith directed attention to their observation that the blood and certain other tissues of the rabbit contain, after injection of insulin, a substance which reacts as a carbohydrate towards the α-naphthol test, but has no reducing action on copper salts even after acid hydrolysis. Commenting on this they say: "It seems possible that the carbohydrate content of the animal body may be not appreciably diminished after large doses of insulin. The above facts would suggest that the sugar stored in the body as glycogen is converted into this peculiar form."

If I understand the suggestion correctly, it is that this unidentified carbohydrate substance is formed from glucose under the influence of insulin. If this is so, it should be present in normal blood and other tissues, but absent from those of diabetics.

Jackson has recently shown (*J. Biol. Chem.*, 1923, lvii. 121) that adenine nucleotide occurs in normal human blood. I have myself recorded its occurrence, together with other nucleotides, in the pancreas of

the dogfish (*J. Biol. Chem.*, 1921, xlv. 263), and pentose compounds, which have in many cases been identified as nucleotides, and are probably always present as such, have been found distributed through a wide range of animal tissues.

Is it possible that the carbohydrate substance referred to by Messrs. Winter and Smith is of a nucleotide nature? The nucleotides give the α-naphthol test, but there is a possibility of the pentose constituent, to which the reaction is due, escaping notice on testing a solution after acid hydrolysis for reducing power, especially if only a small quantity of material is available, moderately strong acid is used, and the hydrolysis is carried out in an open vessel at the boiling-point, since, in these circumstances, the pentose readily goes over to furfurol and is lost by volatilisation.

I hazard the suggestion for this reason. I have recently found that the tissue of the islet gland in a typical teleost fish (*Ophiodon elongatus*, Girard) is the richest in pentose compounds (nucleotides) of all the tissues of the body, notably richer than the zymogenous pancreatic tissue. Since it has been shown that the islet gland in such fishes is homologous with the isles of Langerhans in the mammalian pancreas, I have suggested, in a paper on the subject which is shortly to appear in the *Journal of Biological Chemistry*, that it would be justifiable to infer from this that the general high pentose content of the pancreas in mammals is due mainly to the presence of the isles of Langerhans.

With the view of tracing a connexion between the high pentose content of the islet tissue and its function of insulin production, I have made use of the hypothesis, put forward by Heilbron and Hollins (Rep. Brit. Ass., 1922, 396) to explain the formation of compounds of the C_5 series from those of the C_6 series in plants, that hydroxymethyl-furfuraldehyde is first formed by loss of water, and this goes over to a member of the C_5 series by respiratory oxidation. This transformation would seem to necessitate the pre-formation of an activated form of glucose, and I have suggested that the plant hormone, glucokinin, described by Collip (*J. Biol. Chem.*, 1923, lvi. 513) probably performs the function of activation.

If this is so, and pentose is formed in the animal organism from activated glucose by a similar series of steps as is postulated for plants, it seems to indicate a connexion between the production of insulin and the high concentration of pentose compounds in the islet tissue.

If there is anything in this idea it may also be applied to explain the production of pentose compounds in the blood and other tissues under the action of insulin, and it would be interesting in this connexion to determine whether adenine nucleotide occurs in the blood of diabetics.

C. BERKELEY.

Marine Biological Station,
Nanaimo, British Columbia,
October 15.

An Uncommon Type of Cloud.

THERE are many striking cloud phenomena which may be regarded as local. While the same general laws of cloud formation prevail in all climates, yet some forms, while not radically different, display varying degrees of magnitude or intensity in certain parts of the world.

The form known as "mammato-cumulus" or "festoon-cloud" or, as called in the Orkneys, "pocky cloud," is of this nature, and while it occurs in a very pronounced fashion in Australia, the United States, and other countries, it is almost a very rare phenomenon in the British Isles, and then, as a rule, in a very "mild" form.

An illustration which is usually given to represent this type is that which appears in the "International Cloud Atlas." It is from a negative by H. C. Russell, who secured it in Sydney, Australia, in the year 1893. It shows the type in its most intense form.

Less pronounced is the illustration given by M. J. Loisel in his "Atlas photographique des nuages," from a negative he took at Chiavari in Italy in 1908.

Still less pronounced is that given in the "Meteorological Glossary," issued by the Meteorological Office, from a negative by Capt. Cave taken in England in 1915.

It may be remarked that, while almost all books on meteorology refer somewhat in detail to this type of cloud, it is very rare that any illustration from a photograph accompanies the text. The reason for this is evidently due to the fact that this type does not occur very often in the British Isles, and when it does the phenomenon is a fleeting one, lasting for only a few minutes. Having observed and photographed clouds for many years, I have only seen

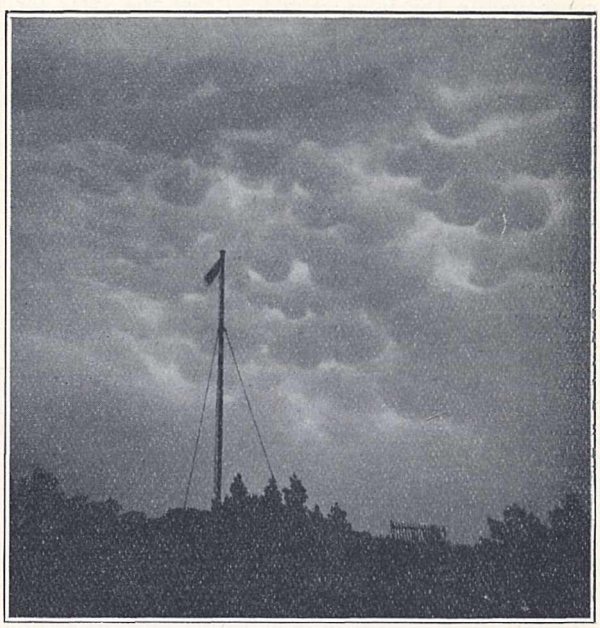

FIG. 1.

this type on about six different occasions and photographed it on three; even then the type was not of a very pronounced nature.

In his book entitled "Cloud Studies," the late Mr. Arthur Clayden writes: "In some countries it seems to be frequently observed, but in England it is so uncommon that the writer has only noticed it about a dozen times in twenty years, and on no one of these did it last long enough to allow of its portrait being taken."

The main feature of this type of cloud is that it occurs on the underneath surface of a large cumulus cloud, and its appearance, in its most pronounced state, is of a globular formation exhibiting a large number of well-defined rounded masses of cloud hanging downwards below the main cloud. The cloud is generally associated with very disturbed atmospheric conditions, heavy rain, and with thunderstorms.

On October 22 last, at 12.45 P.M. G.M.T., an example of this form of cloud, very pronounced for this country, made its appearance at Sidmouth, South Devon, and lasted for only five minutes. I managed to secure two satisfactory photographs of it, one of which is here reproduced (Fig. 1). It shows clearly

the spherical formations hanging downwards with clear cut edges. If the photograph be turned upside down the appearance is that of the tops of cumulus clouds as seen from an aeroplane above them.

Just as the billowy tops of cumulus clouds are due to the *ascent* of warm moist air into cooler air above, so the globular formation of the festoon-cloud must be caused by the *descent* of warm moist air into an underlying cooler stratum. This inversion of temperature is generally indicative of bad weather, and this was corroborated by the weather experienced at and after the time the photograph was taken.

WILLIAM J. S. LOCKYER.

Norman Lockyer Observatory,
Sidmouth, South Devon.

The Tides.

THE great importance of the subject is my excuse for troubling you once more, very briefly, regarding it. In NATURE of July 21, I stated that, according to the present tidal theory, the tidal forces, and consequently the tides, would be just the same for a sea-depth of about 4000 miles as for the actual sea-depth of about 2 miles; and, in the same issue, your reviewer, "The Writer of the Note," agrees that this is true, or, in his own words, "that the differential motion of the oceans is determined by the vectorial excess of the forces at the earth's surface over those at its centre"; which appears to ignore entirely the depth of the ocean as a factor determining the height of the tides.

The theoretical cause of the tides is the difference of the attractions of thesun and moon at the earth's surface and centre. This difference in the case of the moon is more than twice as great as in the case of the sun; therefore, the lunar tide is more than twice as great as the solar tide. Similarly, if the earth were expanded into a hollow, spherical crust of ten times its present diameter, with its water-covered surface nearest to the moon at the same distance as now, and the moon's period of revolution also remaining the same, then the lunar tide-raising force, and consequently the tide, would be about twelve times as great as now. This is the teaching of the present tidal theory; but is it the teaching of practical mechanics and common sense? Why should the mere expansion of the earth cause a ten, or twenty, or a hundred times greater tide upon its surface, the distance of that surface from the moon, as well as the masses of the earth and moon, remaining the same as before the expansion?

Surely this is a question well worthy of discussion; and surely some of your readers are sufficiently interested and open-minded to express some opinion or argument regarding it. EVAN MCLENNAN.

Corvallis, Oregon, U.S.A., September 3.

MR. MCLENNAN'S words "and consequently the tides" are not in accordance with dynamics and are not implied in the passage he quotes from my previous note. If the earth were all water the direct tide-generating forces within two miles of its surface would be the same as in an ocean of depth only two miles. These tidal forces are usually represented by reference to the "equilibrium tide," that is, by stating what the outer surface of the oceans would be if the water had lost its inertia without losing its gravitational properties. This outer surface would be the same in the two cases mentioned. The necessary continual adjustment of water, however, would be quite different in the two cases; in the first case the water within two miles of the surface would be largely raised and lowered by that beneath, while in the second case the water would move mainly in a horizontal direction. But owing to the actual inertia of the water the outer surface of the ocean would be entirely different in the two cases, so that the accepted theory does not ignore the depth of the ocean as a factor determining the height of the tides.

The expansion of the solid earth, with an increase in water sufficient to conserve the depth of the oceans, would magnify the tides because the excess of the forces at the earth's surface over those at its centre would expand with the earth's radius. Mr. McLennan apparently finds this result of the gravitational theory repugnant to his common sense.

THE WRITER OF THE PREVIOUS NOTES.

Stirling's Theorem.

IN connexion with the recent letters published in NATURE on Stirling's Theorem, I beg to say that in a paper accepted for publication by the Academy of Zagreb on July 13, and now in print, I proved in quite an elementary manner the formula

$$n! = \sqrt{2\pi}\,.\,(n+a)^{n+\frac{1}{2}}\,.\,e^{-(n+a)},$$
$$a = 0{\cdot}2113249 \text{ or } 0{\cdot}7886751,$$

which coincides with the results published by Mr. James Henderson in NATURE of July 21, p. 97, formula (3). The error was found to be of the order of $1/72\sqrt{3}n^2$ of the calculated value, where $1/72\sqrt{3}$ is equal to 0·00801875 in Mr. Henderson's results. The formula may also be written

$$n! = p\left(\frac{n+a}{e}\right)^{n+\frac{1}{2}}$$

and the log p determined once for all. (For $a = 0{\cdot}2113249$, we have log $p = 0{\cdot}5244599$.) The work of calculation is then by no means greater than in using Stirling's or Mr. H. E. Soper's formula though the approximation is far closer. I think the doubt inferred by Mr. G. J. Lidstone in NATURE of August 25, p. 283, on the usefulness of the formulæ under discussion is not valid so far as the present one is concerned. For sufficiently large values of n, depending on the number of decimals of the tables, the result calculated from the above formula is not worse than that furnished by any other more complicated formula.

STANKO HONDL.

Zagreb, Croatia, SHS-State,
October 7.

PROF. HONDL'S simplified form of my best first approximation to the value of $n!$ follows at once from the fact that $(b - c) = \frac{1}{2}$ in my letter in NATURE of July 21. [b is Prof. Hondl's a.] The constant p in $n! = p\left(\frac{n+a}{e}\right)^{n+\frac{1}{2}}$ is $\sqrt{2\pi e}^{\,(\frac{1}{2}-a)}$.

We have now three approximations involving this type of expression where the index of the power is $(n+\frac{1}{2})$:

(1) $$\sqrt{2\pi}\left(\frac{n+\frac{1}{2}}{e}\right)^{n+\frac{1}{2}} \text{[Soper]},$$

(2) $$p\left(\frac{n+a}{e}\right)^{n+\frac{1}{2}},$$

(3) $$\sqrt{2\pi}\left(\frac{\sqrt{n^2+n+\frac{1}{6}}}{e}\right)^{n+\frac{1}{2}} \text{[Forsyth]}.$$

It is interesting to note the increase in accuracy as we proceed from (1) to (3). The errors are $1/24n$, $1/125n^2$, and $1/240n^3$ respectively. Of approximations of this type Forsyth's is by far the most accurate, but for logarithmic calculation it is rather more laborious.

JAMES HENDERSON.

Biometric Laboratory,
University College, London.

Thunderstorms and Globular Lightning.

By Dr. G. C. SIMPSON, F.R.S.

THERE is no real boundary between pure science and applied science, and it is inconceivable that any one whose life's work is the practical application of electricity should not be interested in all things electrical. One might, therefore, expect an electrical engineer to show at least a dilettante interest in atmospheric electricity, but one is surprised—although equally gratified—to find that the president of the Institution of Electrical Engineers devoted a large part of his inaugural address on October 18 to the discussion of the electrical potential gradient in the atmosphere and the mechanism of thunderstorms. There has been a great deal of work done on these subjects in recent years, but it cannot be said that the results have yet reached far beyond the small band of workers who are actually engaged in making the investigations. Dr. Alexander Russell has, therefore, done a good service to his fellow engineers in summarising for their benefit our present knowledge and indicating problems still unsolved.

Dr. Russell accepts the breaking drop theory for the origin of electricity in thunderstorms, but he appears unable to give up entirely the old idea that free electrons form nuclei for condensation in the atmosphere. There are certain ideas which once they have appeared in scientific literature cannot be eradicated no matter how conclusively they are shown to be wrong. C. T. R. Wilson in his classical work on the condensation of water on to ions showed two things: first, with great supersaturation water will condense, in the absence of other nuclei, on positive and negative ions; and secondly, that no condensation takes place on even the negative ions until fourfold supersaturation has been reached. This latter point is nearly always forgotten, and until some one has shown that fourfold supersaturation does exist in the atmosphere, meteorologists cannot recognise that ions play any rôle in the processes of atmospheric precipitation.

The breaking drop theory of thunderstorms has met with very wide acceptance; for it gives such a simple and complete account of the origin of the electricity and explains so many of the observed facts, such as the part played by ascending air currents, why the lightning flashes are mainly between the base and the top of the cloud, and why the rain carries sometimes a positive and sometimes a negative charge with the former preponderating.

The physical basis of the theory has been examined in great detail by Lenard in Germany and McClelland and Nolan in Dublin, and there can now be no doubt that the breaking of drops does produce a separation of electricity. There was, therefore, every justification for Dr. Russell to give the breaking of drops as the chief source of electricity in thunderstorms, but this is only a part of the complete theory of thunderstorms, which takes into account the part played by hail and explains also those winter thunderstorms in which there appears to be no drop formation.

The breaking drop theory was put forward as the result of work during the monsoon in India, and in the original paper it was said that there had been no opportunity to examine the electrical phenomena connected with ordinary rain or with snowstorms. That opportunity has since occurred, and has given the data for rounding off the theory so that it can now be applied to all kinds of atmospheric precipitation.

The separation of electricity on the violent disruption of a body is not confined to liquids, but occurs, probably more strongly, when solids are rapidly separated. Rudge's work on the electrification of dust clouds threw much light on this subject. When dust is blown up into the air, the dust particles are found to be highly charged. This is not an effect of frictional electricity as usually understood, because two different substances do not come into contact; for example, highly charged particles are obtained when sand consisting of pure silica is used to make a dust cloud. The effect appears to be exactly the same as in the case of the breaking drops; a violent separation of parts takes place, the substance obtains one kind of electricity while the other kind passes into the air probably in the form of large ions.

Rudge's work was undertaken to explain the high potential gradient observed in tropical regions during dust storms, but similar electrical effects are observed during blizzards in polar climates. There is physically no difference between a dust storm and a blizzard accompanied by much driven snow, and in both cases the particles of solid matter become charged in consequence of their frequent collisions. This is then the origin of electricity in snowstorms. One difficulty, however, must be faced. If the electrification takes place by collision, how does a sufficient separation of electricity take place to give a lightning flash, for this can only occur after some process has widely separated the electricity set free by the collisions? The answer is that so long as the cloud contains only snow which settles very slowly through the air, there is no thunderstorm; it is only when soft hail accompanies a snowstorm that thunder and lightning occur. As the soft hail falls through the snow flakes, electrification takes place on each collision and the falling hail carries away with it large charges of electricity. Thus the fall of the hail effects the separation of electricity which gives rise to the large electrical fields necessary for a thunderstorm. Compared with the electrical effects of a tropical thunderstorm with its heavy rainfall, the electrical effects of a snowstorm are almost insignificant, and during the polar winter, when there is no soft hail associated with the snowfall, thunder and lightning do not accompany the most violent snowstorms.

Dr. Russell in his address also gave considerable time to discussing globular or ball lightning. He came to the conclusion, which is now very generally held, that this is a real natural phenomenon with an objective existence. The chief characteristic of ball lightning may be summed up as follows:

(1) The body or ball itself, which is able to retain its individuality as it moves through the air, appears to be composed of gas or matter in some novel luminous condition.

(2) The balls appear to exist independently of any large electrical intensity, for they have been observed within closed rooms where large electrical fields are impossible, and have also

been observed to pass in and out of parallel telegraph wires.

(3) They appear to be associated directly or indirectly with large quantities of energy, for they have been observed to explode with violence, and have also been seen to fuse the overhead wire of an electrical tramway.

No satisfactory explanation of ball lightning has been offered. Dr. Russell says: "Globular lightning seems to be a brush discharge taking place at the end of a column of air of higher conductivity than the neighbouring air." He then points out some of the difficulties of this explanation, to which others can be added; in fact, there is really nothing very similar between a brush discharge and the ball of glowing gas so frequently described. The only physical phenomena yet produced in a laboratory at all approaching ball lightning is the active nitrogen studied by Lord Rayleigh. In this case we have a mass of nitrogen subjected to an electrical discharge which continues to glow for some time after it has been removed from the field. Lord Rayleigh, however, is unable to accept this explanation of ball lightning, and all that we are able to say is that active nitrogen is the nearest physical phenomenon to ball lightning yet produced in our laboratories. Ball lightning appears always to be associated with a thunderstorm, and it is possible that the intense discharge of a lightning flash can produce some atomic change in the air or rain through which the discharge passes. If this is so, the glowing matter of ball lightning may be in a state otherwise not met with in Nature.

Unusual Forms of Crystallisation of Cementite in Steel.

CEMENTITE, the carbide of iron, which confers on iron the properties of steel, exists in three principal forms in hypereutectoid steels, (1) the pseudo-dendritic form, (2) the cellular or intergranular form, and (3) the intragranular form which gives rise to the Widmannstätten structure. Pseudo-dendritic distribution arises directly from the irregular concentration of the solid solution which results on solidification. The cellular variety occurs between the grains, *i.e.* in the network of the grain junctions, while the Widmannstätten structure is caused by the precipitation of cementite in the interior of the grains themselves and shows evidence of the directive influence of the crystalline network of each grain.

A. M. Portevin has examined a sample of steel which has enabled him to make certain new observations in regard to these forms of cementite. These results were presented at the autumn meeting of the Iron and Steel Institute held recently in Italy. The sample was found in the hearth of a blast-furnace, and its exterior presented the characteristic concave facets peculiar to intergranular fracture. The grains of which it was composed were exceedingly well developed, their size being of the order of 1 cm. in transverse thickness and several centimetres in length. The specimen contained 1·22 per cent. of carbon, 1·35 of silicon, and 0·17 of phosphorus. It was, therefore, very distinctly hypereutectoid and corresponds, so far as carbon percentage is concerned, to a fairly hard cutting tool. An examination of the microstructure of this sample revealed the presence of the cellular and Widmannstätten modes of distribution of cementite, but the pseudo-dendritic form was absent.

Intragranular Cementite.

A micrographic section usually shows the cementite in needles arranged along three or four directions in each grain. This corresponds spacially with lamellæ parallel with the faces of the octahedron, and has the appearance which cementite assumes more particularly in case-hardened samples very high in carbon. In the sample examined by Portevin a different orientation of the intragranular cementite was observed. The constituent was present, not in the usual isolated rectilinear needles, but in the form of bundles of numerous very small needles, or of groups of elements crowded together. These were apparently elongated prisms analogous to the prismoids of Belaiew, grouped in masses. This is apparently the first time that intragranular cementite has been noticed with these morphological characteristics. It can, however, also be produced in steel which has been strongly case-hardened at a very high temperature and very slowly cooled. Inclusions and notably bubbles constituted centres of crystallisation around which the bundles of needles were grouped.

Intergranular Cementite.

This is customarily described and represented as enveloping the grains and appearing in a section as continuous ribbon-like filaments which do not display any characteristic shape or orientation. Howe and Levy, however, have directed attention to the needle points which impinge from the cementite network into the interior of the grains, and have raised the question as to whether these take their direction in obedience to the crystallisation orientation of the adjacent grain or of that of the network itself. They have suggested that both influences manifest themselves, and that sometimes one and sometimes the other predominates. In the present sample there is no continuous network of cementite surrounding the grains. There is a grouping of this constituent along the confines of the grain joints, the variable orientation of which can sometimes be attributed to that of the intragranular elements of cementite dispersed within each grain and sometimes appears distinctly different. In other words, the two influences remarked by Howe and Levy manifest themselves. Fig. 1 represents the appearance obtained after oil-quenching at 950° C. followed by annealing at 550° C., a treatment which causes the great bulk of the pro-eutectoid cementite, and more especially the Widmannstäten cementite, to disappear. The photograph has been taken at the junction of three grains. The needles which compose the network have in one instance different directions in regard to each grain, giving the junction the appearance of the barbs of a feather, while in the two other junctions they have an almost uniform orientation. It appears that the structural elements of the network have distributed themselves along a mean direction or have assumed a direction of their own, the influences of the orientation of each grain conflicting with each other in the neighbourhood of the junction. The needles are

very short and it is difficult to ascertain their orientation with exactitude. The disturbance occasioned in the distribution of the structural elements which separate the grain junctions by the simultaneous influence of the varying orientations of each grain is thus manifest. Portevin remarks that some observers will not fail to interpret them as arising from the intervention of "amorphous material," whereas they can easily be interpreted as the resultant of two forces acting in different directions. He has observed a similar instance in the case of aluminium bronze containing 90 per cent. of copper which has been hardened and annealed. Here the intergranular elements of α separated along the grain joints have a different orientation from that of the acicular intragranular element.

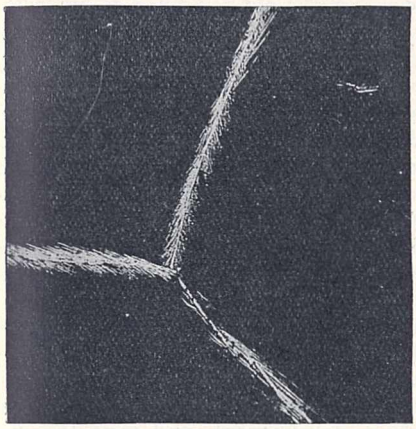

FIG. 1.—Peculiar segregation of cementite at crystal boundaries. × 50.

Cementite, as is well known, is exceedingly sensitive to coalescence phenomena. The author has stimulated the coalescence of the pro-eutectoid cementite of the sample by heating it for 1·5 hours at 950° C. followed by oil-quenching, and then by one hour's annealing at 600° C. This gives darkly-etching sorbite in which the undissolved cementite appears white and is very clearly distinguishable. Under these conditions the coalescence of the cementite prismoids is shown by a rounding of the boundaries and the splitting up of the elements constituting the bundles, but in addition an agglomeration is observed which gives the cementite a pitted appearance and is misleadingly like the eutectic of white pig-iron. (See Fig. 2.) This pseudo-eutectic appearance, due to coalescence, appears to be a new observation and shows the intensity of the influence of surface tension on cementite at the above temperatures. The tension is, in this instance, an important morphological factor.

Another unusual type of occurrence of cementite in steel was described at the same meeting by Prof. Edwards and Mr. Pfeil. In this case, however, the phenomenon was observed in mild steel sheets, *i.e.* in hypo-eutectoid steels. Defects are sometimes encountered in such sheets when subjected to moderately deep stamping operations and consist of a series of corrugations in the side walls of the dish. The degree of corrugation increases on passing from the bottom to the top, and is, in all probability, due to the greater amount of cold work put upon the metal there. It was found that the microstructure of the steel consisted of two approximately equal parts: (*a*) a very coarsely crystalline layer apparently free from carbon, and (*b*) a finely crystalline layer in which no pearlite was present but the carbide was segregated at the crystal junctions in irregular nodules. A section cut from the corrugated part of the dish showed very coarse severely deformed crystals. Running round the crystal boundaries, however, was an almost continuous network of what may be termed "beaded" cementite. This constituent must have segregated from pearlite and coalesced into this form under the influence of surface tension during the annealing. Its appearance is shown in Fig. 3 at a magnification of 250 diameters. So far as the writer is aware, this type of occurrence of cementite in a mild steel has not been previously described. The authors have not proposed any explanation of how it is brought about, but are endeavouring to produce it intentionally. Clearly much work still remains to be done to explain the various forms of cementite which may and do occur in both hypo- and hyper-eutectoid steels.

FIG. 2.—Eutectic-like appearance of cementite. × 500.

FIG. 3.—Beaded cementite at crystal boundaries of ferrite. × 250.

H. C. H. C.

Some Developments of Modern Zoology.[1]

By Prof. J. H. ASHWORTH, D.Sc., F.R.S.

ZOOLOGY has far outgrown its early boundaries when it could be defined simply as a part of natural history, and at no period has its growth been more rapid or more productive in results of scientific and practical importance than during the last two or three decades. That period has witnessed a growth of our knowledge of the living organism of the same order of importance as the progress in our knowledge of the atom. Never have investigators probed so deeply or with so much insight into the fundamental problems of the living animal; the means for observation and recording have become more delicate, and technique of all kinds more perfect, so that we can perceive details of structure and follow manifestations of activity of the organism which escaped our predecessors.

Among the notable features of zoological activity during the last twenty-five years, the amount of work on the physiology of organisms other than mammals must attract early notice in any general survey of the period. Eighty years ago Johannes Müller's physiological work was largely from the comparative point of view, but for some years after his death the comparative method fell into disuse, and the science of physiology was concerned chiefly with the mode of action of the organs of man or of animals closely related to man, the results of which have been of outstanding importance from their bearing on medicine. Interest in the more general applications of physiology was revived by Claude Bernard ("Leçons sur les phénomènes de la vie," 1878), and the appearance of Max Verworn's "General Physiology," in 1894, was in no inconsiderable measure responsible for the rapid extension of physiological methods of inquiry to the lower organisms—a development which has led to advances of fundamental importance. Many marine and freshwater organisms lend themselves more readily than the higher vertebrates to experimentation on the effects of alterations in the surrounding medium, on changes in metabolic activity, on the problems of fertilisation and early development, on the chemistry of growth and decline, and to the direct observation of the functioning of the individual organs and of the effects thereon of different kinds of stimuli. The study of these phenomena has greatly modified our interpretation of the responses of animals and has given a new impetus to the investigation of the biology and habits of animals, *i.e.* animal behaviour.

This line of work—represented in the past by notable contributions such as those by Darwin on earthworms, and by Lubbock on ants, bees, and wasps—has assumed during the last two or three decades a more intensive form, and has afforded a more adequate idea of the living organism as a working entity, and revealed the delicacy of balance which exists between structure, activity, and environment.

The penetrating light of modern investigation is being directed into the organism from its earliest stage. During the summer of 1897 Morgan discovered that the eggs of sea-urchins when placed in a 2 per cent. solution of sodium chloride in sea-water and then transferred to ordinary sea-water would undergo cleavage and give rise to larvæ, and J. Loeb's investigations in this field are familiar to all students of zoology. Artificial parthenogenesis is not restricted to the eggs of invertebrates, for Loeb and others have shown that the eggs of frogs may be made to develop by pricking them with a needle, and from such eggs frogs have been reared until they were fourteen months old. The application of the methods of micro-dissection to the eggs of sea-urchins is leading to a fuller knowledge of the constitution of the egg, of the method of penetration of the sperm, and of the nuclear and cytoplasmic phenomena accompanying maturation and fertilisation, and will no doubt be pursued with the object of arriving at a still closer analysis of the details of fertilisation.

The desire for more minute examination of developing embryos led to the more careful study of the egg-cleavage, so that in cases suitable for this method of investigation each blastomere and its products were followed throughout development, and thus the individual share of the blastomere in the cellular genesis of the various parts of the body was traced. This method had been introduced by Whitman in his thesis on Clepsine (1878), but it was not until after the classical papers of Boveri on Ascaris (1892) and E. B. Wilson on Nereis (1892) that it came into extensive use. For the next twelve or fifteen years, elaborate studies on cell-lineage formed a feature of zoological literature and afforded precise evidence on the mode of origin of the organs and tissues, especially of worms, molluscs, and ascidians. A further result of the intensive study of egg-cleavage has been to bring into prominence the distinction between soma-cells and germ-cells, which in some animals is recognisable at a very early stage, *e.g.* in Miastor at the eight-cell stage. The evidence from this and other animals exhibiting early segregation of germ-cells supports the view that there is a germ-path and a continuity of germ-cells, but the advocates of this view are constrained to admit there are many cases in which up to the present an indication of the early differentiation of the germ-cells has not been forthcoming on investigation, and that the principle cannot be held to be generally established.

A cognate line of progress which has issued from the intensive study of the egg and its development is experimental embryology—devoted to the experimental investigation of the physical and chemical conditions which underlie the transformation of the egg into embryo and adult. By altering first one and then another condition our knowledge of development has been greatly extended. By artificial separation of the blastomeres the power of adjustment and regulation during development has been investigated, and by further exploration of the nature of the egg the presence of substances foreshadowing the relative proportions and positions of future organs has been revealed in certain cases, the most striking of which is the egg of the Ascidian *Cynthia partita* (Conklin, 1905).

Progress in investigation of the egg has been

[1] From the presidential address delivered to Section D (Zoology) of the British Association at Liverpool on September 13.

paralleled by increase in our knowledge of the germ-cells, especially during their maturation into eggs and sperms, the utmost refinements of technique and observation having been brought to bear on these and on other cells. During the last thirty years, and especially during the latter half of this period, cytology has developed so rapidly that it has become one of the most important branches of modern biology. One of the landmarks in its progress was the appearance, at the end of 1896, of E. B. Wilson's book on "The Cell." A great stimulus to cytological work resulted from the rediscovery in 1900 of the principle of heredity published by Mendel in 1865, which showed that a relatively simple conception was sufficient to explain the method of inheritance in the examples chosen for his experiments, for in 1902 Sutton pointed out that an application of the facts then known as to the behaviour of the chromosomes would provide an explanation of the observed facts of Mendelian inheritance. In the same year McClung suggested that the accessory chromosome in the male germ-cells is a sex-determinant. These two papers may be taken as the starting-point of that vast series of researches which have gone far toward the elucidation of two of the great problems of biology—the structural basis of heredity and the nuclear mechanism correlated with sex. The evidence put forward by Morgan and his colleagues, resulting from their work on Drosophila, would seem to permit little possibility of doubt that factors or genes are carried in the chromosomes of the gametes, and that the behaviour of the chromosomes during maturation of the germ-cells and in fertilisation offers a valid explanation of the mode of inheritance of characters. The solution of this great riddle of biology has been arrived at through persistent observation and experiment and by critical analysis of the results from the point of view of the morphologist, the systematist, the cytologist, and the geneticist.

Among other important developments in the period, reference may be made to the great activity in investigating the finer structure of the nerve-cell and its processes. By 1891 the general anatomical relations of nerve-cells and nerve-fibres had been cleared up, largely through the brilliant work of Golgi and Cajal on the brain and spinal cord, and of von Lenhossék, Retzius, and others on the nervous system of annelids and other invertebrates. In these latter had been recognised the receptor cells, the motor or effector cells, and intermediary or internunciary cells interpolated between the receptors and effectors. In June 1891 Waldeyer put forward the neurone theory, the essence of which is that the nerve-cells are independent and that the processes of one cell, though coming into contiguous relation and interlacing with those of another cell, do not pass over into continuity. He founded his views partly upon evidence from embryological researches by His, but chiefly on results obtained from Golgi preparations and from anatomical investigations by Cajal.

The neurone theory aroused sharp controversy, and this stimulus turned many acute observers—zoologists and histologists—to the intimate study of the nerve-cell. First among the able opponents of the theory was Apáthy, whose well-known paper, published in 1897, on the conducting element of the nervous system and its topographical relations to the cells, first made known to us the presence of the neurofibrillar network in the body of the nerve-cell and the neurofibrils in the cell-processes. Apáthy held that the neurofibrillar system formed a continuous network in the central nervous system, and he propounded a new theory of the constitution of the latter, and was supported in his opposition to the neurone theory by Bethe, Nissl, and others. The controversy swung to and fro for some years, but the neurone theory—with certain modifications—seems now to have established itself as a working doctrine. The theory first enunciated as the result of morphological studies receives support from the experimental proof of a slight arrest of the nerve-impulse at the synapse between two neurones, which causes a measurable delay in the transmission.

The latest development in morphological work on nerve-elements is the investigation of the neuromotor system in the Protozoa. Sharp (1914), Yocom (1918), and Taylor (1920), working in Kofoid's laboratory, have examined this mechanism in the ciliates Diplodinium and Euplotes, and they describe and figure a mass—the neuromotorium—from which fibrils pass to the motor organs, to the sensory lip, and, in Diplodinium, to a ring round the œsophagus. The function of the apparatus is apparently not supporting or contractile, but conducting. By the application of the finest methods of microdissection, specimens of Euplotes have been operated upon while they were observed under an oil-immersion objective. Severance of the fibres destroyed co-ordination between the membranelles and the cirri, but other incisions of similar extent made without injuring the fibrillar apparatus did not impair co-ordination, and experiments on Paramæcium by Rees (1922) have yielded similar results. While the experimental evidence is as yet less conclusive than the morphological, it supports the latter in the view that the fibrils have a conducting, co-ordinating function. Progress in our knowledge of the nervous system is but one of many lines of advance in our understanding of the correlation and regulation of the component parts of the animal organism.

The ciliate Protozoa have been the subject during the last twenty years of a series of investigations of great interest, conducted with the purpose of ascertaining whether decline and death depend on inherent factors or on external conditions. While these researches have been in progress we have come to realise more fully that ciliates are by no means simple cells, and that some of them are organisms of highly complex structure. Twenty years ago Calkins succeeded in maintaining a strain of Paramæcium for twenty-three months, during which there were 742 successive divisions or generations, but the strain, which had exhibited signs of depression at intervals of about three months, finally died out, apparently from exhaustion. From this work, and the previous work of Maupas and Hertwig, the opinion became general that ciliates are able to pass through only a limited number of divisions, after which the animals weaken, become abnormal and die, and it was believed that the only way by which death could be averted was by a process of mating or conjugation involving an interchange of nuclear material between the two conjugants

and resulting in a complete reorganisation of the nuclear apparatus. Jennings has shown that conjugation is not necessarily beneficial, that the ex-conjugants vary greatly in vitality and reproductive power, and that in most cases the division rate is less than before conjugation. Woodruff has since May 1, 1907, kept under constant conditions in culture a race of Paramæcium. During the sixteen years there have been some ten thousand generations, and there seems no likelihood of or reason for the death of the race so long as proper conditions are maintained. The possibility of conjugation has been precluded by isolation of the products of division in the main line of the culture, and the conclusion is justifiable that conjugation is not necessary for the continued life of the organism. The criticism that Woodruff's stock might be a non-conjugating race was met by placing the Paramæcia, left over from the direct line of culture, under other conditions, when conjugation was found to occur. Later observations by Erdmann and Woodruff show that a reorganisation of the nuclear apparatus of Paramæcium takes place about every twenty-five to thirty days (forty to fifty generations). This process, termed endomixis (in contrast to amphimixis), seems to be a normal event in the several races of Paramæcium which Erdmann and Woodruff have examined, and it is proved to coincide with the low points or depressions in the rhythm exhibited by Paramæcium.

Enriques (1916) maintained a ciliate—*Glaucoma pyriformis*—through 2701 generations without conjugation, and almost certainly without endomixis. From a single "wild" specimen he raised a large number and found that conjugating pairs were abundant, so that the objection could not be made that this was a non-conjugating race. Enriques then began his culture with one individual, and examined the descendants morning and evening, removing each time a specimen for the succeeding culture. The number of divisions per day varied from nine to thirteen, and as there was no break in the regularity and rapidity of division, and no sort of depression, Enriques concluded that neither endomixis nor conjugation could have occurred, for these processes take some time and would have reduced considerably the rate of division. These results, especially if they are confirmed by cytological study of preserved examples, show that for Glaucoma neither conjugation nor endomixis is necessary for continued healthy existence. Hartmann's observations (1917) on the flagellate *Eudorina elegans* extend the conclusion to another class of Protozoa. He followed this flagellate through 550 generations in two and a half years. The mode of reproduction was purely asexual, and there was no depression and no nuclear reorganisation other than that following fission. The evidence seems sufficient to confirm the view that certain Protozoa, if kept under favourable conditions, can maintain their vigour and divide indefinitely, without either amphimixis or endomixis.

Child (1915) states as the result of his experiments that the rate of metabolism is highest in Paramæcium and other ciliates immediately after fission—"in other words, after fission the animals are physiologically younger than before fission." This view, that rejuvenescence occurs with each fission, derives support from the observations of Enriques and Hartmann, for no other process was found to be taking place and yet the vigour of their organisms in culture was unimpaired. If, then, fission is sufficiently frequent—that is, if the conditions for growth remain favourable—the protoplasm maintains its vigour. If through changes in the external conditions the division rate falls, the rejuvenescence at each fission may not be sufficient to balance the deterioration taking place between the less frequent divisions. Under such conditions endomixis or conjugation may occur with beneficial results in some cases, but if these processes are precluded there is apparently nothing to arrest the progressive decline or "ageing" observed by Maupas and others.

The culture of tissues outside the body is throwing new light on the conditions requisite for the multiplication and differentiation of cells. R. G. Harrison (1907) was the first to devise a successful method by which the growth of somatic cells in culture could be followed under the microscope, and he was able to demonstrate the outgrowth of nerve-fibres from the central nervous tissue of the frog. Burrows (1911), after modifying the technique, cultivated nervous tissue, heart-cells, and mesenchymatous tissue of the chick in blood-plasma and embryonic extract, and this method has become a well-established means of investigation of cell-growth, tissues from the dog, cat, rat, guinea-pig, and man having been successfully grown. One strain of connective tissue-cells (fibroblasts) from the chick has been maintained in culture in vigorous condition for more than ten years—that is, for probably some years longer than would have been the normal length of life of the cells in the fowl. Heart-cells may be grown generation after generation—all traces of the original fragment of tissue having disappeared—the cells forming a thin, rapidly growing, pulsating sheet. Drew (1922) has recently used instead of coagulated plasma a fluid medium containing calcium salts in a colloidal condition, and has obtained successful growth of various tissues from the mouse. He finds that epithelial cells when growing alone remain undifferentiated, but on the addition of connective tissue differentiation soon sets in, squamous epithelium producing keratin, mammary epithelium giving rise to acinous branching structures, and when heart-cells grow in proximity to connective tissue they exhibit typical myofibrillæ, but if the heart-cells grow apart from the connective tissue they form spindle-shaped cells without myofibrillæ.

For many lines of work in modern zoology biochemical methods are obviously essential, and the applications of physics to biology are likewise highly important—*e.g.* in studies of the form and development of organisms and of skeletal structures. Without entering into the vexed question as to whether all responses to stimuli are capable of explanation in terms of chemistry and physics, it is very evident that modern developments have led to the increasing application of chemical and physical methods to biological investigation, and consequently to a closer union between biology, chemistry, and physics. It is clear also that the association of zoology with medicine is in more than one respect becoming progressively closer. Comparative anatomy and embryology, cytology, neurology, genetics, entomology, and parasitology, all have their bearing on human welfare.

Obituary.

PROF. JAMES SULLY.

THE death of Prof. James Sully, which took place in London on November 2, at eighty-one years of age, removes from among us one of the few survivors of the philosophical school for whom psychology was a mental science distinct from and yet analogous to natural science. His "Teachers' Handbook of Psychology" was for many years the standard text-book of the subject, and his treatise, "The Human Mind" the generally recognised authority on the science. Since he retired in 1903 from the Grote professorship of mind and logic at University College, London, which he had held for ten years, he has lived in retirement. To most of the present generation he is known by the honour accorded to his name in the membership lists of learned societies.

Sully's works on psychology show him still in the main under the influence of the Associationists, Mill and Bain, notwithstanding that he imparted to his subject a wide range of interest. He had no part in the revolution which has overtaken the teaching of psychology. He had studied before the days of laboratory appliances and apparatus for making practical experiments and devising mental tests. Also he was before the rise of psycho-analysis and took no part for or against the medical theories. His particular bent was towards the educational aspect of his subject and his great interest was child-study.

James Sully was born at Bridgwater on March 3, 1842. His parents were Baptists, and he was educated with the intention of preparing himself, should he receive the call, for the Baptist ministry. He went to Taunton Independent College, and afterwards to Regent's Park Baptist College, where he took the London M.A. degree with a gold medal. He then went to Germany, first to Göttingen, and afterwards to Berlin to attend the lectures of Hermann Lotze. He took a post of classical tutor in a Baptist College, but shortly afterwards resigned it and at the same time definitely abandoned the intention of taking a pastorate. Instead he took up journalism. He soon began to make his mark as an author. His book "Pessimism," 1877, gained general recognition as a work of wide and original philosophical interest. Most of his books, however, were technical treatises or handbooks for students. An "Essay on Laughter," 1902, "Italian Travel Sketches," 1912, and quite recently a volume of "Reminiscences" were his last works.

In the time of his full activity Sully lived at Hampstead, the centre of a literary circle which included many well-known names. He was an active member of Leslie Stephen's famous society for Sunday tramps. Among his close personal friends were Henry Sidgwick, Herbert Spencer, G. H. Lewes, Shadworth Hodgson, Cotter Morison, William James and Henry James, and George Meredith.

DR. E. K. MUSPRATT.

THE death, on September 1, of Dr. Edmund Knowles Muspratt, honorary president of the United Alkali Company Ltd., and a former Pro-Chancellor of the University of Liverpool, is deeply regretted by all who know his public work and intellectual influence.

Born in 1833, the youngest son of James Muspratt, the founder of the great alkali industry of Lancashire, Dr. Muspratt studied chemistry in early life under Liebig, becoming one of his intimate personal friends and following him when he moved from Giessen to Munich. About the year 1856 he entered his father's business, and thus was associated for the rest of his life with the alkali and acid industry of Lancashire, afterwards becoming a director and, later, chairman of the United Alkali Co.

Dr. Muspratt was one of the great citizens of Liverpool who played a leading part in the establishment, first of the University College, and later of the University of Liverpool. A man of wide culture and outlook and a sincere believer in learning and research, he did everything in his power to further the cause of higher education in Liverpool. Together with his friend, the late Sir John Brunner, he was instrumental in obtaining a charter for the new University. For many years he acted as a member of the Council, and by his influential support, wise and broad-minded advice, and generous benefactions, proved himself to be one of the greatest friends the University possessed. Amongst his benefactions may be mentioned the Laboratory of Physical Chemistry, with which his name was associated by the University.

Dr. Muspratt was widely interested in science, literature, music, the drama, politics, and public life. At Seaforth Hall, near Liverpool, his father's home (and also his own to the close of his life), he met many of the most interesting personalities of the time, including Charles Dickens, Samuel Lover, Sheridan Knowles the dramatist (who acted as his godfather), Macready, Douglas Jerrold, Mark Lemon, Miss Charlotte and Miss Susan Cushman. This tradition of culture, friendship, and hospitality was carried on by Dr. Muspratt, so that Seaforth Hall was always the home of wit, learning, and good fellowship.

Dr. Muspratt travelled a great deal in Europe (and in America). In 1917 he published a very interesting and delightful book entitled "My Life and Work."

In the England of fifty years ago there did not exist the great modern "city" Universities of Birmingham, Bristol, Leeds, Liverpool, Manchester, and Sheffield. Their creation in the face of many obstacles and difficulties has been due to the far-sighted vision and true liberalism of a comparatively small number of men. In this select company of great scholars and great English citizens, the name of Edmund Knowles Muspratt holds an honoured and distinguished place.

F. G. D.

DR. P. W. LATHAM.

DR. P. W. LATHAM, for twenty years Downing professor of medicine at Cambridge, who died on October 29 at Clifton, Bristol, was a notable teacher and practitioner of medicine, working ceaselessly into advanced life for the progress of his science. He died a week after the completion of his ninety-first year. The Downing professorship, entered upon in 1874, was

relinquished in 1894, and five years later Dr. Latham voluntarily resigned from the active staff of Addenbrooke's Hospital, Cambridge. Born at Wigan, in 1832, the eldest son of Dr. John Latham, he was educated there and apprenticed to his father. Later he entered the University of Glasgow, and at Gonville and Caius College, Cambridge. In the first class of the Natural Sciences Tripos of 1859 his sole companion was Henslow the botanist. In the following year he was elected to a fellowship at Downing and proceeded in due course to the degrees of M.B. and M.D. He also studied at St. Bartholomew's Hospital and in Germany.

Dr. Latham's earliest scientific interest after his return to Cambridge was tuberculosis, but in time he passed to the consideration of a wide range of pathological studies and to chemical physiology. His Croonian Lectures in 1886 showed his leaning towards these aspects of medical science; while in the Harveian Oration delivered two years later he lent his support to the advocacy of such theories as those of Koch and Metchnikoff which were rapidly leading to the formulation of modern views concerning disease and tissue reaction. Many of the problems of that time have since been solved; for example, the place of caseous tubercles in the disease complex associated with infection by tubercle bacilli; and some, like that of the transformability of organisms one into another, have been set aside or forgotten. Dr. Latham's hypothesis concerning the molecular structure of living protoplasm, further, was not acceptable; but he assisted notably in the dissemination of scientific ideas of disease and contributed in clear terms, if not prolifically, to current discussions.

By the death of Dr. Charles Proteus Steinmetz, the electrical engineering profession loses one of its most distinguished members. He was born at Breslau in 1865, and after studying at Breslau, Berlin, and Zürich, he went to America. In 1903 he was elected professor of electrical engineering at the Union University, New York. He was a voluminous author, and his books on mathematical electrical engineering are well known all over the world. He was also chief consulting engineer to the General Electric Co. of America and carried out many successful researches. We mention specially his researches on the electric strength of air and on the magnetite arc. As a mathematician he was not widely read, but he displayed great originality. He did much to help the United States to become the leading country in the world in high-tension electrical engineering. On hearing of his death the English Institution of Electrical Engineers in England cabled a message of condolence to the Institute and said that "his work lives and will continue to live."

Current Topics and Events.

Mr. Robert Hutchinson, president of the National Association of British and Irish Millers, read a paper on "The Economic Basis of Wheat-growing in England" at the annual meeting of the fellows of the National Institute of Agricultural Botany on November 2. The only way, he said, of preventing the area under wheat from being further reduced was to raise the price to a profitable level. This is not impossible if a wheat is obtainable which combines with the productivity, the stiffness of straw and the resistance to disease of the best English wheats, the "strength" which puts so high a premium on the best Canadian wheats. "Strength" is the mysterious factor which determines the size, shape, and palatability of a loaf. For many years it was believed that a strong wheat could not be grown on English soils or in the moist English climate. Wheats imported for experimental purposes from Canada, Russia, Hungary and Turkey all lost their quality within a few years. But one wheat, Canadian Red Fife, has been proved to retain its strength unimpaired after 21 successive years' growth in England. Prof. R. H. Biffen, working on Mendelian lines, has proved that strength is a dominant characteristic, and by crossing Red Fife with high-yielding English wheats has already given the farmer Yeoman wheat, which without admixture of foreign wheats will yield satisfactory bread. But, in Prof. Biffen's own words, the sooner Yeoman is off the market the better, for a series of new wheats believed to combine the best characteristics of Canadian and English varieties, and adapted to different types of soils, are now growing at the Cambridge Plant Breeding Institute, and it is hoped to market the first of these through the National Institute of Agricultural Botany in the autumn of 1924. If the promise of these wheats materialises, English wheat will be lifted from the category of kinds to be bought for breadmaking only when the price is low into the category of kinds desired and essential. This change would revolutionise the financial prospects of English wheat-growing.

Of recent years the great development of agricultural education and research in Great Britain has attracted considerable attention throughout the Empire. The number of research workers spending some time at centres such as the Rothamsted Experimental Station is rapidly increasing. In the majority of cases they are sent officially by the Dominion Government concerned. A further example of this co-operation is furnished by the recent departure of Sir John Russell, Director of the Rothamsted Experimental Station, on a special mission to the Sudan. He will be associated with Dr. H. Martin Leake, Director of Agriculture for the United Provinces of India, in advising the Sudan Government on its agricultural policy. In view of the enormous possibilities for growing cotton in the Sudan, agricultural research work will be mainly concerned with cotton. The first instalment of the great irrigation scheme in the Gezira plain south of Khartoum is expected to come into operation in the autumn of 1925. At this stage 300,000 acres will be put under irrigation, of which 100,000 acres will be under cotton; but the total scheme is capable of development over an area

of 3,000,000 acres. In approaching Sir John Russell and Dr. Leake, the Sudan Government has been actuated by the desire to get the best possible advice as to the organisation and direction of the agricultural research work which should be undertaken in connexion with this project, which may ultimately produce 1,000,000 bales of cotton a year. It is hoped that the Empire Cotton Growing Corporation will co-operate with the Sudan Government in the research work to be carried out, and that this work can be co-ordinated with a general plan for research work on cotton problems to be organised throughout the British Empire.

IN the United States National Museum there is an exhibit of the original Patent Office models of the more important dynamos and arc and incandescent lamps which have been invented in America. There are also copies of the original commercial apparatus made after these models. In particular there is a series of incandescent lamps visualising chronologically the development of the Edison lamp from its inception. With this collection in view, Mr. H. Schroeder has written a "History of Electric Light," which has been published by the Smithsonian Institution. The earliest work on filament lamps dates back to 1841, when J. W. Starr, an American, did valuable experimental work and took out patents for "a metallic or carbon conductor intensely heated by the passage of electricity for the purpose of illumination." The carbon pencil operated in a barometric vacuum. An illustration is given of Edison's carbon filament lamp of October 21, 1879, which embodies the main features of the modern filament lamp. No mention is made, however, of the work of Sir Joseph Swan, who developed, between 1878 and 1880, the parchmentised cotton thread filament and ultimately the squirted thread of cellulose, which soon became the universal process. No mention is made of John Hopkinson in connexion with the three-wire system, and we do not agree with the statement on p. 54 that the use of 220-volt lamps is less economical than the use of 110-volt lamps, as they are less efficient. The savings effected in the mains by using the higher pressures have to be taken into account before a decision can be made. The excellent work done by the Germans and Americans in developing the metal filament and gas-filled lamps is well described. The output of electric lamps in the United States alone is 200 millions per annum, and is rapidly increasing.

A SOMEWHAT curious pamphlet has been sent to us by its author, Mr. J. H. Goodchild, of Muswell Hill (London: Simpkin, Marshall and Co.; price 1s.). It bears the attractive title of "Landscape and History"; but the history is that of the rocks which landscape-painters are invited to portray. Mr. Goodchild believes that the ordinary descriptions in geological text-books fail to impress on the mind the continuity of the processes that go on within a rock mass and that make it, at any moment, what it is. He appeals to the artist, with his use of colour, to help the untrained observer to appreciate what he sees. It seems to us that a good deal of description would be required to explain what the painter had striven to represent, and that the current changes and the life-history of the rocks would be much better understood after a few excursions with, say, the Geologists' Association in the field. Mr. Goodchild's views on the origin of "igneous" rocks by segregative processes among the sediments that they appear to penetrate were recently stated in NATURE (vol. 110, p. 589); but how would these processes be expressed by a painter, even if he were gifted with the brain of Leonardo da Vinci and the palette of Tintoretto? The late Mr. Brett was criticised by his fellow-craftsmen because a geologist could always feel sure as to the rocks represented in his fine and vivid pictures of coast-scenery. Mr. Goodchild probably remembers Brett; but he looks farther for an artist of almost supernatural powers, who shall enable us to "visualise"—to use a popular term—the water trickling within a headland of white chalk, or the veins of sulphide ores rusting in confinement underground. We think that we have grasped his meaning; but the pamphlet, even with the aid of its illustrations, possibly does not do full justice to the views that he wishes to propound.

THE publication of Vol. I., No. 1, of the Proceedings of the Cambridge Philosophical Society, Biological Series, is in effect the first appearance of a new biological journal, in which it is proposed to publish research work done at Cambridge in zoology, botany, and physiology. This first number does not perhaps give an adequate idea of the standard of work of this kind which is being done in the University Laboratories, as the papers are all of a rather slight character, and do not include any outstanding scientific discoveries of first-class importance. Dr. D. Klein's account of the structure and life-history of a new type of Schizogregarine parasitic on the larva of a fly is a piece of careful descriptive writing, and is well illustrated. Two papers by Mr. J. T. Saunders dealing with hydrogen ion concentration and the methods of its determination, with applications of these methods to the measurement of the carbon dioxide output of freshwater animals, are useful additions to the rapidly increasing literature on this modern method of biochemical research, and Mr. F. A. Potts's paper on the structure and function of the liver of the ship-worm (Teredo) is suggestive, though not pretending to be an account of a finished research on the subject. There is a short paper by Miss D. Eyden on the vertical distribution of *Daphne pulex* and one by Messrs. F. T. Brooks and W. C. Moore on the invasion of woody tissues by wound parasites, both of which are valuable. The number concludes with a description of a fossil alga from the Middle Cambrian by Mr. J. Walton. The journal, which is issued by the University Press, is well produced, though many will find that the excessive length of the line on the printed page causes the reader unnecessary discomfort.

FOR the benefit of private analysts and others concerned, Mr. C. B. Saunders (National Institute of Agricultural Botany, Cambridge) describes in detail

the methods of seed analysis developed and used at the Official Seed Testing Station. A critical account is given of the various methods of sample-taking and tests for purity and germination, the advantage or otherwise of each being indicated. The various classes of plants, as clovers, grasses, vegetables and cereals, require different treatment in order to obtain the best results in germination tests, questions of substratum, moisture supply and temperature needing separate consideration for each class. In some cases the methods adopted in other countries are described and the reasons given for varying the procedure at the English Official Station. The paper is entirely practical in outlook, all theoretical considerations being reserved for a future handbook on the theory and practice of seed-testing for the use of seed analysts and agricultural students.

By the generosity of Mr. S. Berkeley Smith of Karachi, the Cheltenham Public Museum has acquired on permanent loan one of the largest collections of Chinese porcelain in the provinces. The collection has arrived in 122 packing cases, weighing nearly 5 tons, and has now been arranged for exhibition. It includes a splendid twelve-fold lacquer screen; Céladon and Fanville Rose enamels; Mazarin blue jars; porcelain of the Kang Hsi period (1662-1722); a large and valuable set of plates and bowls of the Ming period (1367–1640). Next we have examples of Imperial Yellow China; the Peach Bloom type, and so-called "Indian Porcelain." The collection of Céladon ware dating back to the Sung Dynasty (960–1250) is specially important. Mr. Berkeley Smith has also sent to Cheltenham some sixty old Chinese pictures. The arrangement in the Museum is well adapted to display this important collection, on the acquisition of which Cheltenham, by the generosity of the donor, is to be warmly congratulated.

The Report of the Earthworks Committee of the Congress of Archæological Societies in union with the Society of Antiquaries is a record of steady progress. Happily, reports of destruction are few and unimportant. The value of the appointment of Mr. O. G. S. Crawford in connexion with the Ordnance Survey is shown in the identification of the sites of earthworks which have been lost sight of, and in archæological county surveys, such as that which has been set on foot in Surrey, and in survey of Welsh Hill Forts, inaugurated by the Board of Celtic Studies of the University of Wales, is fully recognised. The importance of such work is shown by the valuable discoveries made by Mr. E. Hart at Bletchingley, by Mr. Toms at Cissbury Ring, and by the honorary secretary and Mr. G. E. Cruickshank along the course of the Wansdyke, where there appear to be whole groups of settlements hitherto unrecorded. Even in a London suburb Mr. B. Barham has discovered extensive remains of an ancient dyke. Full accounts of the other activities of the Committee in excavation and exploration are given in the Report.

A book of normals of meteorological elements for the British Isles, Section IV., has just been issued by the Meteorological Office, Air Ministry, and published by H.M. Stationery Office. It has been prepared in the hope that it may prove of interest for holiday-makers, to those engaged in agriculture, to doctors and invalids. Average temperatures and the highest and lowest which may be expected, the average amount of rainfall and the number of days with rain, together with the range of variation, are given for each month of the year for 30 selected places. There are frequency tables showing for each month, and for the year, the normal number of days with hail, thunder, snow, and ground-frost. Such health resorts as Bath, Torquay, Brighton, and Eastbourne do not appear in this book of normals, but naturally there must be some limit to the number of places dealt with. An earlier book of normals, Section I., contains many places omitted in the new publication, but Section I. was more for the statistician.

Notice is given that applications for the government grant for scientific investigations for the year 1924 must be sent to the offices of the Royal Society, Burlington House, W.1 (upon forms obtainable from the Clerk to the Government Grant Committee), by, at latest, January 1 next.

A superintendent of agriculture is required by the Department of Agriculture of the Sudan Government. Particulars of the appointment can be obtained from the Inspecting Engineer to the Egyptian and Sudan Governments, Queen Anne's Chambers, Westminster, S.W.1. Applications should be marked "Superintendent of Agriculture."

A mycologist is required in connexion with the Ceylon Rubber Research Scheme. Candidates should be honours graduates of a British university with at least one year's post-graduate work in mycology or equivalent qualifications. Further information and application forms may be obtained, upon written request, from the Assistant Private Secretary (Appointments), Colonial Office, Whitehall, S.W.1.

Sir Jagadis Bose, director of the Bose Institute, Calcutta, will deliver a lecture at the Royal Society of Medicine on "Assimilation and Circulation in Plants," on Thursday, December 6, at 5.30 p.m. It will be illustrated on the epidiascope and Sir Jagadis will exhibit his apparatus in operation. The chair will be taken by the president of the Society, Sir William Hale-White.

At the annual general meeting of the Cambridge Philosophical Society held on October 29, the following officers were elected for the session 1923–24:—*President*: Mr. C. T. Heycock. *Vice-Presidents*: Prof. A. C. Seward, Dr. H. Lamb, Mr. J. Barcroft. *Treasurer*: Mr. F. A. Potts. *Secretaries*: Prof. H. F. Baker, Mr. F. W. Aston, Mr. J. Gray. *New Members of the Council*: Mr. F. P. White, Mr. E. V. Appleton, Mr. J. B. S. Haldane.

The ninety-eighth course of juvenile lectures at the Royal Institution to be delivered this Christmas by Sir William Bragg is entitled "Concerning the Nature of Things," and will deal with (1) the atoms of which things are made; (2) the nature of gases;

(3) the nature of liquids; (4), (5), and (6) the nature of crystals—(*a*) diamond; (*b*) ice and snow; (*c*) metals. The first lecture will be given on Thursday, December 27, and the succeeding ones on December 29, 1923, and January 1, 3, 5, and 8, 1924. This will be the first course of lectures to be delivered at the Royal Institution by Sir William Bragg since his appointment by the Board of Managers of the Royal Institution in June last to be Fullerian professor of chemistry and director of the Laboratory and of the Davy-Faraday Research Laboratory.

AT a meeting of the Linnean Society of New South Wales held on August 29, a proposal for the reservation of all areas in New South Wales with altitude greater than 4000 ft. was discussed, and it was resolved "that this Society desires to advocate the reservation from alienation and the more conservative administration of the Crown Lands of New South Wales on which grow the upland forests at the sources of the principal rivers for the following considerations: (1) the quality and regularity of river supply, (2) the preservation of undergrowth and timber, and (3) the preservation of the fauna and flora of scientific value; and that the terms of this resolution be conveyed to the State Government for consideration."

THE governing body of the Imperial College of Tropical Agriculture, realising the need for the provision of scientific workers and technologists if the sugar industry of the British Empire is to be developed and our dependence on foreign countries for our sugar supplies obviated, is establishing and equipping at St. Augustine, Trinidad, a model sugar factory towards which the British Sugar Machinery Manufacturers are contributing plant to the value of 20,000*l*. It is expected that the factory will be completed next year, and meanwhile the governing body has appointed Mr. E. C. Freeland to be professor of sugar technology, and Mr. P. E. Turner to be his assistant and demonstrator. Mr. C. L. Withycombe and Mr. E. E. Cheesman have been appointed demonstrators in zoology and entomology, and botany, respectively.

A COLD snap has recently occurred in many parts of England, and the *Times* of November 9 states that the frost experienced on the previous morning was the sharpest recorded for many years in the early part of November. In the screen the thermometer fell to 19° F. at Leamington, Andover, and Shoeburyness, while on the grass the radiation thermometer registered 11° at Shoeburyness. At Kew, the shade temperature fell to 22° F., which is said to be a "record" for the first ten days of November, being 2° lower than the previous "record" on November 10, 1921. At Greenwich Observatory the thermometer in the screen fell to 23° F. and the radiation thermometer registered 14° F. On November 10, 1908, the thermometer in the screen registered 22° F., which is the lowest temperature at Greenwich for the first ten days of November since 1841, a period of 82 years, while on the grass the radiation temperature was 9° F., which is the lowest radiation temperature at any time in November since 1856, when the thermometer registered 8·5° F. on November 30.

THE Optical Society of America held its eighth annual meeting at Cleveland, Ohio, on October 25, 26, and 27, the business being conducted in the physics building of the Case School of Applied Science. The meetings for the reading of papers were open to non-members, and abstracts of all papers to be read were available before the meetings. Twenty-eight papers were read, including one on the optical problems of an Art Museum, by Mr. F. A. Whiting, director of the Cleveland Museum. Prof. Michelson gave a paper on the limit of accuracy in optical measurement, and Prof. Nichols one on the spectra of incandescent oxides. Seven of the papers dealt with geometrical and general optics, eight with vision, colorimetry and photometry, and the rest with the optics of instruments and with miscellaneous optics. They originated from the Bureau of Standards, the Eastman Research Laboratory, the Research Laboratory of Bausch and Lomb, the Nela Research Laboratory, the Munsell Research Laboratory, the Research Laboratories of the American Telephone and Telegraph Co. and the Western Electric Co., from Frankland Arsenal, and from the laboratories of many of the American universities and technical schools. America is evidently alive to the necessity for research in optics.

PARTICULARS of a very complete series of adjustable resistances of the type consisting of a tube, or in some cases of a block, of rectangular section wound with a single layer of bare wire over which a sliding contact moves, are contained in a new catalogue from the Zenith Manufacturing Co. (Villiers Road, Willesden Green). The range of these has been extended to cover a variety of requirements, from compact laboratory resistances to large switchboard apparatus. Several improvements in design have been made, notably in the way in which the tubes are gripped in their holders and in the clamping on the broad metal rings at the ends, which form the terminals and zero contacts. The resistances can be connected up in a variety of ways and can be wound non-inductively when required. In some cases also it is found convenient to provide them with windings of increasing cross section, by which method some saving in space and material can be obtained, as the section of the conductor can be made to increase approximately at the same rate as the current when the slider is moved to diminish the resistance in circuit.

MESSRS. W. AND G. FOYLE, LTD., 121 Charing Cross Road, W.C.2, have just sent us a copy of the catalogue of their department No. 18, of 569 second-hand books on alchemy, magic art, curiosities, utopias, natural sciences, mining, architecture, mechanics, and their bibliography and literary history. It will repay perusal. A welcome and unusual feature is the inclusion of an index of proper names.

AMONG the announcements of the Oxford University Press is a new edition of "English Industries in the Middle Ages," by L. F. Salzman, in which

will be included much fresh material and many illustrations reproduced from medieval originals. The work will treat of mining, quarrying, building, metal-working, pottery, clothmaking, leather-working, fishing, brewing, and the control of industry.

THE latest catalogue (No. 228) of Messrs. W. Heffer and Sons, Ltd., Cambridge, is an important one. It contains upwards of 1300 titles of second-hand works classified under the following headings: scientific periodicals and transactions of scientific societies, standard scientific books, standard sets and periodicals in English, historical and general literature, foreign literature, oriental literature and journals, and addendum.

THE new announcement list of Messrs. Longmans and Co. gives particulars of the three following books which should be of interest to engineers: "Reinforced Concrete Design," by G. P. Manning, in which the subject-matter is treated from the point of view of the engineer designer. It will include the theory and practice of design as generally admitted and employed at the present day; "Applied Elasticity," by Dr. J. Prescott, written to fill a gap which has existed between the two extremes of English text-books on elasticity. Strict mathematical methods are used wherever these are not too cumbersome, and approximate methods are used to simplify the cumbersome methods; and "The Principles of Irrigation Engineering, with special reference to South Africa," by F. E. Kanthack.

MESSRS. EDWARD ARNOLD AND CO. announce the early publication of "Outlines of Palæontology," by Prof. H. H. Swinnerton, of the University College, Nottingham, in which palæontology is dealt with as a definite branch of science and not as an adjunct to stratigraphical geology, or as a mere division of zoology. The method of treatment adopted arises from the difficulty felt by students of geology and zoology and by others interested in the problems of animal life and evolution in past ages in being able to visualise all the salient characters for which a number of generic or specific names stand sufficiently clearly and completely for the purpose of making mental comparisons. This fact has been borne in mind by the author, and consequently most problems are discussed in terms of organs and structures rather than of organisms and species.

Our Astronomical Column.

TWO COMETS.—A telegram from the Cape announces that Comet Doubiago-Bernard has been observed there, and that the following orbit has been deduced:

$$T = 1923, \text{ Nov. } 17{\cdot}70$$
$$\omega = 254^\circ\ 32'$$
$$\Omega = 227\ \ 36$$
$$i = 114\ \ 17$$
$$\log q = 9{\cdot}8976$$

The comet will return north early next year and may possibly be visible with large instruments in February and March. It travelled to nearly 70° S. Decl.

Herr Reinmuth, assistant to Prof. Max Wolf at Königstuhl, Heidelberg, detected a cometary object on October 31 at $8^h\ 44{\cdot}5^m$ local M.T. in R.A. $1^h\ 15^m\ 4^s$, N. Decl. 22° 31′. Daily motion is probably -32^{sec}, north 28′, but as the discovery was made photographically the motion may possibly have been in the reverse direction. The photographic magnitude is given as 13·0. The discovery was made in the course of the minor planet work that is regularly carried on at Königstuhl.

POLARITIES OF SUNSPOTS.—Much interest was caused at the meeting of the Royal Astronomical Society on November 9 by the reading of notes by Prof. Hale and Mr. Ellerman announcing that the Mt. Wilson observations confirmed the reversal of the polarity law for the constituent spots of double groups in the sunspots of the new sunspot cycle. The evidence now suggests that the law persists throughout one 11-year cycle, and is reversed for the following one.

Prof. Newall pointed out that this means the substitution of a 22-year cycle for solar changes, instead of the previously accepted 11-year cycle. He noted that the discovery increased the difficulty in obtaining a mechanical explanation of sunspot phenomena, since the magnetic polarities depend on the directions of the vortex motions round the spots.

THE FIREBALL OF NOVEMBER 3.—This object was observed at 6.53 P.M. at Bristol, Bodmin (Cornwall), and other places, though very few observations of a satisfactory kind have come to hand. Mr. W. F. Denning writes that the real path of the object was directed from north to south, the beginning of the luminous course of the meteor being over the region of Torquay, and the end over the English Channel about 64 miles S.S.E. of Start Point. The radiant point was at 160°+59° near β Ursæ Majoris, from which point a bright meteor was also seen on October 14 last. This shower appears to be continuous during the last three months of the year. In any case it has been repeatedly observed from the second week of October up to the last week in December.

In the spring months of March and April the same radiant in Ursa Major is manifested with great distinctness. This long continuance or frequent repetition in meteoric radiation deserves further investigation.

SUNSPOTS AND CHANGES IN SOLAR RADIATION.—Prof. Abbot's announcement of the short-period changes in solar radiation was made several years ago. He examines (Proc. Nat. Acad. Sci., U.S.A., Oct. 1923) how far a connexion can be traced between visible changes on the solar disc and the radiation changes. His results are as follows:

1. The appearance of sunspots is accompanied by high radiation, presumably owing to the uprush of hotter matter from the interior.

2. Lower radiation generally occurs just after the central transit of spots.

3. Generally a disturbed solar surface means high radiation, a quiescent surface low radiation.

With regard to (2), he refers to Guthnick's observations of the brightness of Saturn. The fluctuations could be made to accord with the variations of radiation, on the supposition that the radiation is different in different directions, a time-correction being necessary for the difference of longitude of the earth and Saturn. It is suggested that above sunspots there are veiling rays, analogous to the coronal rays, which cause absorption of radiation.

Research Items.

THE "SHRUNKEN HEADS" OF THE JIBAROS.—In "Blood Revenge, War and Victory Feasts of the Jibaro Indians of Eastern Ecuador," by Rafael Karsten, which has been issued as Bulletin 79 of the Bureau of American Ethnology, a section deals with the methods of preparation of, and beliefs attaching to, the shrunken heads which form the war trophies of these tribes. Much attention was attracted to this subject by Sir John Bland-Sutton's lecture before the Royal Society of Medicine in November last (see the *Lancet*, November 11, 1922, p. 995; *Brit. Med. J.*, November 11, 1922, p. 932). These heads, which have been made familiar by a number of specimens in our museums, are usually about the size of an orange, the skin, with the hair attached, having been stripped from the skull by an incision at the back. Three strands of twisted red-painted cotton hang from the lips, and the whole head is dyed with charcoal. The hair, which is held to be the seat of the soul, is the most essential part of the trophy. The head is regarded as charged with supernatural power, and is never that of an enemy belonging to the same tribe as that of the slayer, with whom blood relationship might be claimed, as the process of reduction is a deadly insult to the whole tribe. Each stage of the process has its appropriate ritual. The reduction is begun by the use of three stones heated in a fire, this being obviously ceremonial, as the actual reduction is afterwards effected by the use of hot sand introduced through the opening of the neck. Heads of certain animals such as the sloth and the jaguar, are prepared by the same method and with identical ceremonial, because at one time all animals were men who fought among themselves and took one another's heads as trophies.

POLYNESIAN TYPES.—In vol. xxii., No. 2, of the Journal of the Polynesian Society, Dr. Louis R. Sullivan discusses some of the anthropometric data obtained in the Pacific by the Bayard Dominick Expedition of the Bernice Pauahi Bishop Museum of Honolulu and the American Museum of Natural History. From material collected in Samoa, Tonga, the Marquesas, and Hawaii, Dr. Sullivan has isolated two types which he calls tentatively Polynesian and Indonesian. The characteristics of the Polynesian type are light-brown skin colour, wavy hair, medium development of beard and body hair, lips of average thickness, moderately long head (cephalic index 77-78), high face, high but broad nose, and tall stature; of the Indonesian type, medium to dark-brown skin, wavy hair, scant beard and body hair, thick lips, short heads (cephalic index 81-82), stature shorter than the Polynesian, very low broad face and very low broad nose. This hitherto unsuspected Indonesian element, Dr. Sullivan thinks, explains the often-expressed opinion that the Polynesian and Indonesian are closely related types. When the Indonesian traits are removed, the Polynesian appears to be strikingly Caucasoid, and the available data seem to indicate a type intermediate between Caucasian and Mongol. On the other hand, the Indonesian type seems to be a somewhat doubtful Mongoloid diverging toward the Negrito. This type is most important as an element of the population in Tonga and the North-Western Marquesas. In addition, there is a Melanesian element in the south and west of Polynesia—in Tonga, New Zealand, and Easter Island; but Dr. Sullivan is of the opinion that Melanesian influence has been slightly exaggerated. The group exhibiting a high degree of brachycephaly (cranial index frequently 90 and over), occurring notably in Tonga, Samoa, Tahiti, and to a lesser degree in the Marquesas, to which Prof. Elliot Smith has referred as Proto-Armenoid, he regards as Polynesian with an artificially deformed head.

THE UNKNOWABLE.—It is rather curious to reflect on the completely different aspect which Spencer's theory assumes to us to-day, by reason of the change which has come over our mathematical and physical conceptions. Spencer thought of positive science as a realm of clear and transparent light surrounded by a murky realm of metaphysical darkness, and he expressed this firmly-held conviction by describing the outer darkness as the unknowable. To mathematicians and physicists to-day it is, on the contrary, these outer limits, this beyond of the world of sense-perception, of which they feel most confident that they possess sure and precise knowledge. The electron theory and the principle of relativity, which concern fundamental concepts, seem to us more secure scientifically than the sense-perceived objects of practical life. It is these which have sunk back into the mystery of the unknowable. This is not, however, the line of Mr. Santayana's thought expressed in his Herbert Spencer lecture, "The Unknowable," delivered at Oxford on October 24 and now published (Clarendon Press). For him Spencer's unknowable is a doctrine of substance, and he thinks that when the self-contradictoriness of Spencer's statement is corrected it can be brought into line as a sound Spinozistic conception. "Calling substance unknowable," he says, "is like calling a drum inaudible, for the shrewd reason that what you hear is the sound and not the drum. It is a play on words, and little better than a pun."

METABOLISM IN DIABETES.—A vast mass of data relating to the metabolism of diabetics has been accumulated since 1908 by Dr. E. P. Joslin, of Boston, working in association with Dr. F. G. Benedict, of the Nutrition Laboratory, and these are analysed and discussed in Publication 323 of the Carnegie Institution of Washington. In all, 113 patients have been examined in greater and less detail, partly in the period when the prevalent treatment was overfeeding with a low carbohydrate and high protein-fat diet, and partly since the introduction of fasting and under-nutrition as the general regime in 1914. The figures provide a great quantity of accurate measurements which will be examined with profit by those interested in the subjects.

EFFECT OF MANGANESE ON PLANT GROWTH.—Certain elements that occur only in very small amounts in plant tissues would appear to play some definite part in the economy of the plant. J. S. McHargue (*Journ. Agric. Research*, xxiv. pp. 781-794) has investigated the effect of manganese sulphate on the growth of plants in water cultures with specially purified nutrient salts, and his results indicate that at least for the plants tested, a very small quantity of manganese is essential to produce normal growth. Such plants as radish, soy bean, cow-pea, field pea, and maize do not contain sufficient manganese for growth to maturity, though some have sufficient to maintain a normal development for the first few weeks. In the latter case experiments carried on for too short a time fail to reveal the essential nature of manganese. The lack of manganese affects the production of dry matter and brings about an etiolated condition of the young leaves and buds, suggesting that the element has a function in photo-synthesis and in chlorophyll formation. Experiments carried on in soil showed that manganese

sulphate applied to acid soil caused a decrease in crop, whereas if calcium carbonate was applied in addition to neutralise the acidity, increased yields were obtained. Soluble salts of manganese in acid soils may therefore be one of the causes of toxicity in such soils as exhibit toxic effects, an excess of manganese sulphate rendering a soil more or less sterile with respect to the growth of plants.

SILVER-LEAF DISEASE.—The fourth of the series of papers on this subject by Mr. F. T. Brooks and his co-workers appears in the *Journal of Pomology*, Vol. iii., No. 3, September. With financial aid from the Ministry of Agriculture, these important investigations are extending in scope, and besides experiments at Cambridge and at the John Innes Horticultural Institution, Merton, work has been done upon orchard trees at the East Malling Fruit Research Station and at Heston, Middlesex. The parasitic fungus *Stereum purpureum* is responsible for the typical silver-leaf disease, and in this fourth report, Brooks and H. H. Storey criticise Bintner's recent attempt to distinguish a false "silver-leaf" disease due to other physiological causes while pointing out that the silvery appearance, due usually to the optical effects produced by an air gap between leaf epidermis and mesophyll, may frequently arise from accidental disturbances quite unconnected with the entry of *Stereum purpureum*. The experiments now recorded show that the fungus readily infects the living wood at any exposed surface, penetrating such tissues more readily than shoots previously killed in the autoclave, in which it seems to be less active than many saprophytic moulds. A very interesting description is given of the conditions found in Pershore plums which had been infected by the disease and then "grew out" of it. On examination the dead fungus patches could be seen in the wood sharply delimited from the healthy tissues by a band of gum excreted from the tissues. The accumulation of these gum-like substances both in diseased tissues and at the surface of a healthy wound are obviously profitable subjects for further study. Brooks and Storey record many observations on natural wound protection in fruit trees and upon the usual dressings applied to protect such wounds; in their experience gas tar has been the most valuable dressing, Stockholm tar proving very disappointing as a means of protecting wounds against fungal attack.

DISSECTING A DEVONIAN FISH.—A palæontologist of our acquaintance is wont to dream of finding a palæozoic fossil with all its soft parts so beautifully preserved that he can dissect them. Our friend will be envious when he reads in the annual report of the Field Museum of Natural History (Chicago, 1923) how Dr. Erik Stensiö, the new head of the Palæontological Department of the Swedish State Museum, spent ten days at Chicago dissecting the head of a Devonian fish, Macropetalichthys. This specimen, it is said, allowed Dr. Stensiö to obtain an exact knowledge of the shape of the brain and details of the nervous and circulatory system of the head. These facts might possibly have been inferred from the petrified skeletal tissues; but the report says precisely: "The preservation of these soft parts was so perfect that they could be studied almost as well as if it were a fresh specimen." The specimen has been mounted for museum exhibition in such a way as to make a complete whole with all the dissected parts visible, and with every portion removable for close study. Zoologists will await with interest the publication of Dr. Stensiö's memoir.

FREE RADICLES.—J. B. Conant and A. W. Sloan have recently published a preliminary paper on the formation of free radicles (J. Amer. Chem. Soc., vol. 45, p. 2466). The reduction of triphenylpyrylium chloride with vanadous chloride yields a reddish substance which is insoluble in water and behaves as a free radicle. The same reducing agent reduces triphenylcarbinol in concentrated hydrochloric or sulphuric acid solution to free triphenylmethyl.

CELLULOSE DERIVATIVES.—The technology of cellulose derivatives is discussed in an article in the *Chemical Trade Journal* for October 19, which is mainly devoted to the newer ethers and esters. The preparation of cellulose butyrates is receiving attention, because by introducing more complex acid radicals it is hoped to prepare esters with useful solubility properties. The interest in the cellulose ethers has directed attention to improvements in the manufacture of diethyl sulphate, these being discussed in the article. The properties of the various esters and ethers are given.

PRESERVATION OF WOOD.—The *Chemical Trade Journal* for Oct. 5 contains an article on wood preservatives. The art of wood preservation dates back from very early times; it was practised by the Egyptians, who used antiseptic oils for the purpose. Burnett in 1838 introduced the use of zinc chloride; Wolman in 1906 patented the use of certain fluorides in conjunction with other salts, and from this date hundreds of patents on the subject have been taken out. In recent times the creosoting process has been introduced, but it confers odour and inflammability on the timber. The methods of impregnation are discussed in the article, and the results obtained from the uses of various salts are described. A note is also added on the preservation of wood pulp.

MAGNETIC DECLINATION AT KEW.—A careful detailed study by Dr. C. Chree, of the "Absolute daily range of magnetic declination at Kew Observatory, Richmond, 1858 to 1900," has just been published in the Geophysical Memoirs (vol. iii. No. 22) of the Meteorological Office. The annual variation of the daily range is examined by subdividing the year into 73 five-day periods; for each group of five days the 42-year mean daily range is given, also the largest and least values; smoothed means are given also for years of sunspot maximum and minimum. The ranges are, of course, distinctly less in minimum than in maximum sunspot years. The daily range undergoes a double oscillation in the course of a year, with maxima at the equinoxes and minima near the solstices. Again, Wolf's linear relation, $R = a + bS$, connecting the range R with the sunspot number S, is examined; a and b are found to vary quite considerably both throughout the year and from one year to another. The determination of a and b does not in itself give a measure of the degree of correlation between R and S, and this question is separately investigated. The mean correlation coefficient for the whole period is 0·86, but in the mean of the winters it is only 0·53, while there are conspicuous variations in the results for the four groups of years, each roughly comprising one sunspot period, into which the whole series is divided. Interesting frequency tables are also given (*a*) showing the distribution of ranges of different sizes, in each individual year, for the said four groups of years, for sunspot maximum and minimum years, and for each month of the year; and (*b*) showing the distribution of the hour of daily maximum and minimum declination for similar groups of the data. The paper contains a large amount of important though technical information; the results would be more readily comprehended if they had been indicated by graphs based on the numerous tables.

Palæontologists at Vienna.

THE Palæontologische Gesellschaft is an international society of palæontologists, with members belonging to several European nations, to Great Britain, and to the United States. An annual meeting was to have been held in London and Oxford during August 1914, but on account of the War and its effects it was impossible until the present year to hold a meeting outside Germany. Even now the difficulties were only overcome by the aid of the Austrian Government and the generosity of many notable Viennese, who made a meeting in their capital possible for their impoverished colleagues. Thus it was that on September 24 - September 29 a most successful gathering of 53 members and 90 interested persons took place in the University of Vienna under the presidency of Prof. Othenio Abel.

The non-Austrian members included Prof. Wiman of Uppsala, Professors Van Bemmelen and Versluys from Holland, Baron Fejerváry of Buda-Pest, Prof. Pompeckj of Berlin, with 36 German colleagues, Dr. F. A. Bather of the British Museum, and representatives of Czechoslovakia and Jugoslavia.

The congress was honoured in having its session opened in the Festival Hall of the University by the President of the Austrian Republic, Dr. Hainisch, supported by his Vice-chancellor, Dr. F. Frank, Dr. Maurus representing the Minister of Education, and the Rector of the University, Prof. C. Diener. The large gathering listened to an address by Prof. Pompeckj on "The Beginnings of Life," which, in his opinion, took place on the land and not in the sea. Here may be mentioned the dinner in the Rathaus, also attended by the President of the Republic, when speeches of welcome were made by the president of the society and the Deputy-Mayor. The honour of returning thanks on behalf of the foreigners was allotted to Dr. Bather, who dwelt on the power of scientific intercourse to unite the nations, and showed how the advance of science, and notably of palæontology, was retarded by the vexatious barriers still erected by politicians.

The purely scientific programme included the following papers. Baron Fejerváry: The origin of the præ-hallux and the Cheiropterygium theory in the light of palæobiological research; C. Wiman: on some flying Saurians; F. A. Bather: Cothurnocystis, a study in habits and evolution, also Stephanocrinus, a study of convergence; R. Richter: Convergence among Trilobites; H. Schmidt: The development of the Ammonoidea in the Carboniferous; P. Kessler: Nautilids with incomplete septa, which led to a discussion on their mode of life; R. Kubarth: Researches on recent and fossil conifer woods; O. Abel: The first find of a Tetrapod track in the Alpine Trias. The chief interest of the meeting, however, centred in the so-called Drachenhöhle at Mixnitz on the Mur in Steiermark. In this cavern, 1000 metres above the sea, there has been found a remarkable series of cave-bears in all stages of skeletal growth, as well as the remains of smaller mammals associated with them. These have been studied by Prof. Abel and his assistants K. Ehrenberg, O. Antonius, A. Bachofen-Echt, and others. These all described their particular researches, and Prof. Abel in a public lecture drew a vivid picture of the animal life of the "Dragon's Cave."

Opportunity was given to the members to visit Schönbrunn, where the menagerie still contains a fine representation of wild Bovidæ, and the Geological and Mineralogical galleries of the Natural History Museum. An afternoon was devoted to an excursion to the Pallerstein in the Wiener Wald, where the Eocene flysch preserves most curious markings, for the most part of annelid origin. At the close of the meeting 70 members visited the Mixnitz cave, and after spending four hours in the study of its mysteries, were refreshed by a delightful supper and entranced by Styrian folk-songs sung by a choir of local ladies. Fifteen managed on the following day to ascend the Sonnwendstein near Semmering under the guidance of Prof. Kober.

The following have been elected officers for the ensuing year. President: O. Abel (Vienna); Vice-Presidents: O. Jaekel (Greifswald) and E. Stromer (Munich); Secretaries: O. Antonius (Vienna), R. Richter (Frankfort); Treasurer: P. G. Krause (Berlin). New members of Council are F. A. Bather (London) and W. Janensch (Berlin).

The warmest thanks of all who enjoyed this inspiriting gathering are due to Prof. Abel, who, with his colleagues Dr. K. Ehrenberg and Dr. O. Antonius, saw to all the arrangements. Nor should there be forgotten the fine reconstruction of the mammoth made under their direction by the artist Franz Roubal, or the members' badge based thereon by Prof. R. Marschall. The "enkel Bier-abend," where some found a more intimate hospitality in Dr. and Mrs. Abel's home, was a characteristic and delightful feature. But it is more fitting to end with mention of Prof. Abel's "Palæobiologischer Lehrapparat," where he has accumulated a most interesting series of fossils illustrating what one may term their natural history. Nowhere else have we seen this idea so consistently carried out. This room, like the meeting as a whole, was a constant reminder that neither fossils nor those who study them need be dull and lifeless creatures.

Deterioration of Structures in the Sea.[1]

THE investigations on the deterioration of structures of metal, concrete, and timber exposed to the action of sea-water which are being carried out under the direction of a committee of the Institution of Civil Engineers have already formed the subject of two interim reports (see NATURE, October 21, 1920, p. 235, and December 30, 1922, p. 878). The third report, which has just been issued, records progress along several very different lines of research, although, since the phenomena with which they are concerned are slow in developing, conclusive results are not to be looked for in a short space of time.

That part of the work of the committee which deals with the corrosion of metals is the subject of several sections of the report. A full account is given of the arrangements devised for exposing test bars of various types of iron and steel to the action of the sea. The bars, prepared under the supervision of Sir Robert Hadfield and Dr. J. N. Friend, have been despatched to Plymouth, Halifax, Colombo, and Auckland, and reports are given from the engineers in charge at these places describing the methods used for fixing them in position. Groups of bars are to be exposed for five, ten, and fifteen

[1] "The Deterioration of Structures in Sea-Water." Third (Interim) Report of the Committee of the Institution of Civil Engineers. Edited by P. M. Crosthwaite and G. R. Redgrave. Pp. 79. Department of Scientific and Industrial Research (H.M. Stationery Office). Price 3s.

years respectively, after which they will be returned for examination and weighing.

Meanwhile, laboratory work on the same subject is being continued, and the present report includes a short but important communication from Dr. Friend on the influence of strain on the corrodibility of iron and steel, which is of more than merely technical interest. It has long been known that iron, after being subjected to strain, is particularly liable to corrosion, but little exact investigation has been done on the subject. Dr. Friend has carried out a series of experiments on sections cut from bars that had been broken in the tensile tests carried out for the committee. These bars represented seven kinds of wrought-iron and steel, the chemical and physical properties of which had been exactly determined, as well as the degree of strain as measured by the amount of elongation at the points at which the sections were cut. The specimens, isolated on paraffin blocks to prevent any galvanic action, were exposed for a whole year to alternate wetting and drying by tap water in a siphon tank, and the amount of corrosion determined by weighing. The result was, briefly, to show no difference in corrosion between strained and unstrained sections except in the case of a nickel steel (36 per cent. Ni) and less clearly in a chromium steel (13 per cent. Cr). Both these steels, and especially the latter, were very resistant to corrosion, but the percentage difference between strained and unstrained portions is described as "extraordinarily great, resembling in magnitude that observed when strained metals are subjected to acid attack." Dr. Friend is careful to point out that the uniform rates of corrosion in the other irons and steels are not to be taken as contradicting practical experience. In the tests electrolytic action was carefully excluded, but in practice strained and unstrained portions of the metal would be in continuous contact and the difference of potential so produced might well account for the localised and severe corrosion often observed.

A very different field of work is that concerned with the destruction of timber by animal pests, of which the most important are the various kinds of "shipworms" commonly referred to as Teredo. Prof. George Barger reports on experiments in treating wood with various preservatives. The test pieces, after impregnation with the poisonous solutions, were "baited" by attaching a veneer of untreated wood, and were exposed to attack by Teredo at Lowestoft. The most remarkable results were obtained with an arsenic compound, phenarsazine, known in poison-gas warfare under the names "D.M." and "Adamsite." In 1 per cent. alcoholic solution this compound entirely prevented the Teredos from penetrating the test-blocks, although they were numerous in the veneer; even in a dilution of 0·1 per cent. the protection was all but complete.

Mr. C. R. Harington carried out at the Laboratory of the Marine Biological Association at Plymouth some very interesting experiments on the larval development of Teredo. The free-swimming larvæ were kept alive for a fortnight, but attempts to find a suitable food for them failed, and, although they were attracted to and settled on shavings of wood, it was not possible to observe their boring. An important and novel result was the discovery of the manner in which they are attracted to the wood. It was found that alcohol and ether extract from wood a substance which has a strong chemotropic action on the larvæ. Photographs and diagrams are given to show how the larvæ congregate round a small particle of the extract when it is placed in the dish in which they are swimming. Experiments were then made with solutions of various pure substances in capillary glass tubes closed at one end and placed in sea water containing the larvæ. Of the substances tested in this way, malic acid was the only one showing a very pronounced attraction. Whether this is actually the attractive substance occurring in wood, however, has not yet been ascertained.

It is to be noted that neither Prof. Barger nor Mr. Harington mentions by name the species of Teredo used in their experiments, and the possibility that the Lowestoft Teredo may be different from that found at Plymouth is not even referred to. Yet the zoological no less than the physical or chemical data of the experiments deserve to be determined with all possible precision. Closely allied species of animals often differ widely in their physiological reactions. One man's meat is another man's poison, and, although no species of Teredo is likely to grow fat on phenarsazine, it cannot be assumed without trial that a poison efficient at Lowestoft would be equally so at Colombo or even at Plymouth.

A contribution of a very different type is a "Report on Boring Organisms in various Waters" by Mr. J. E. Cunningham of Sydney. It contains a series of statements of the most amazing kind regarding the natural history of Teredo. As an example we may quote the assertion "that full-grown worms will leave a piece of timber and enter another." It is a great pity that the committee should have thought fit to include a report of this character in an official publication.

Invention and Research in Mechanical Engineering.

MANY workers in applied science have an interest in patents and patent law, and to such the remarks made by Sir John Dewrance in his presidential address to the Institution of Mechanical Engineers on October 19 will be of value. Patents and research have occupied a good deal of the president's working life, and consequently they were dealt with very comprehensively in his address.

Some of the large engineering concerns of to-day were started to work patented inventions, but if we look back it is difficult to find very many of these inventions that became the standard productions of the industry when the monopoly expired. It has become increasingly difficult to invent anything that has not been foreshadowed in some previous publication. Patents have gradually become of less importance in mechanical engineering.

Sir John Dewrance has taken out 114 patents; when a definite object is desired, the practice of his firm has been to search its own records to see what has been done before; the Patent Office records are then consulted. Various methods are then evolved and discussed; some of these get no further, whilst others are made, tried, altered, and improved, and the result is exactly what has been felt ought to have been done without all the trouble taken. If the article finds a ready sale, an infringer may adopt the converse process by searching the Patent Office and other records, and producing what is called a mosaic anticipation—one detail is shown in one patent, another in a second, and so on. It has always seemed to Sir John to be unfair that documents should be evidence of anticipation; evidence should be of prior use, and the extent of that use should be sufficient to prevent fraudulent evidence being accepted. The object of a patent specification is that the industry

may be informed exactly how to carry out the invention after the monopoly has expired. If the industry carry out the invention as described, there is ample evidence of use, but in the large proportion of cases the public do not wish to avail themselves of the privilege. Cases are known of specifications being quoted forty years after being filed, during which period there had been no use in accordance with the specification. If the industry has not exercised the privilege of use, and the subsequent inventor has eliminated the defects that prevented the previous patent from coming into use, surely he has good ground for claiming that he has produced a new manner of manufacture.

No less than 16,172 patents were sealed in 1907. Of these 677 were paid up for the sixteenth year in 1922, *i.e.* 4·2 per cent. Of these 677 patents, excluding ordnance, less than 100 related to mechanical engineering. When we realise that only one mechanical patent in 10,000 is worth exploiting, and the industry has to bear the cost in brain power, fees, etc., it seems probable that it would be cheaper for the industry to associate to test designs such as is now being done for research, standardisation, and the other associated activities.

The chief difference between research and invention is that, when conducted by an association of the industry, the results belong to the industry, but the rights of a patented invention belong temporarily to the patentee. The mind of an inventor is liable to exhibit a preference for those designs which may become subject-matter for a patent. The mind of the research worker should be quite free from such restraint, the only object being the best possible result suitable for general adoption and, in some cases, standardisation. It is remarkable that when fixing standards it is seldom, if ever, the British Engineering Standards Committee has wished to adopt an appliance that has been the subject of a patent. The activities of research associations, learned societies, technical colleges, and the British Engineering Standards Association will undoubtedly increase and perform a great many of the duties that in the past were performed by patentees.

Sir John gave an account of the various bodies which are promoting research, and said that it would take too long to give a complete list of the researches in progress—researches that no single firm could carry out wisely or successfully. Such researches can be undertaken only by associations, which those interested ought to assist in every way possible for the benefit of the industry as a whole. Every one who uses knowledge successfully ought to do something to obtain further new knowledge. Sir John desired to impress upon his audience the increasing confidence and hope that, in the future, research will help us to surmount our difficulties. It is of importance that all research workers should realise that by "team" work they must justify and increase this confidence. The nation is watching the result, and critics are not wanting—some are useful and some take a narrow view. We have now opportunities that we never had before, and with British determination we can confidently expect great developments in the future, far exceeding those that have been accomplished in the past.

The New Chemistry.[1]

By Dr. E. F. ARMSTRONG, F.R.S.

IT can be argued that we have just entered on a new stage in chemical investigation. Labours in the main of an analytic type have enabled the exact structure of all but a very few substances to be established: the results have been confirmed by synthetic operations, and most compounds have been built up step by step from their elements. Whilst physicists of the modern school, by a series of most brilliant researches, have learnt much about the nature of the atom, the chemist is now concerned with the behaviour of the molecule. This has entailed the recognition that he has not only to deal with crystals and relatively simple molecules in solution but also to consider actions taking place at the surface of colloid aggregates. As it is probable that the bulk of the reactions in the plant and animal cell are of this nature, their importance will be at once conceded. Further, it must be realised that there is evidence that molecules in solution have a definite space orientation at such colloid surfaces, and indeed according to the work of Hardy at surfaces in general.

According to the accepted space lattice theory of matter, there is a definite attraction causing adhesion between each layer of molecules, and consequently at a surface, say of a piece of glass, there are unsatisfied forces or valencies. At first when a drop of a lubricant is placed on such a surface nothing happens, but when two surfaces of glass are moved over one another the molecules of the lubricant become arranged according to a definite pattern. The chemist to-day, in seeking to explain chemical action, has to realise that this takes place in many instances between aggregates of molecules and at the surface of such aggregates, and not between single simple molecules in solution such as his equations postulate and the ionic theory in its original form demands.

The first fact which has emerged from the detailed study of chemical action at a surface is that the action is not one of the so-called first order in which the same fraction of the reacting substance undergoes changes in successive equal intervals of time—a change expressed graphically by a logarithmic curve. When proper and sufficient care is taken to keep the surface active, the rate of change is uniform, provided that the changing substance is present at the surface in sufficient quantity. These facts are in accord with the hypothesis that action is preceded by the formation of an additive unstable complex which breaks down in all possible ways, that is, into a variety of components, practically as fast as it is formed. The problem of the source of the energy necessary to effect this is not without interest, but it is common to all chemical reactions and its discussion may safely be left to the exponents of the quantum and other theories.

Such actions as we are considering are known as catalytic, the change being effected by virtue of the activity of the catalyst surface, the only other agent involved in practically all cases both in the living cell and the test tube being water. It is now recognised that the water molecule can undergo rupture in two ways, either being distributed upon a single molecule, which is thereby resolved into two others:

$$A.O.B + H.OH = A.OH + B.OH,$$

or divided between two molecules in such manner that whilst the one is oxidised the other is reduced:

$$A + 2H.OH + B = AO + H_2O + BH_2.$$

Entirely different classes of catalysts bring about the two actions, but all are classed as enzymes when

[1] Synopsis of an address delivered to the South Wales Section of the Society of Chemical Industry on November 8.

concerned with changes which take place in the cell. Such enzymes as are well known are highly specific and selective, a different enzyme being required for each class of compound.

Armed with the knowledge of the fundamentals of chemical action in the cell, the time is ripe for the chemist to ascertain the inner meaning of phenomena which the biologist can investigate only by the recording of external visual characteristics. As a case in point, the coloration of flowers and its inheritance may be cited. There is much in favour of the view that flower colours, whether anthocyans or belonging to other groups, are the product of the interaction of two factors, an oxidase and a colourless precursor of the pigment. The absence of either factor means failure to develop colour by the plant, that is, white flowers, and there may also be a third factor present which prevents action taking place between oxidase and leucobase.

If proper combination of effort between the biologist and chemist can be ensured, numerous baffling problems, many of which are of far-reaching economic importance, can be attacked. As illustrating one such, in which that all-essential factor quality is concerned, the puzzling fact well known to agriculturists may be mentioned, that one pasture can fatten stock whereas another is of very little value for this purpose.

University and Educational Intelligence.

CAMBRIDGE.—Dr. Horace Lamb, Trinity College, has been appointed to give the first Rouse Ball lecture on some subject related to mathematical science.

Mr. M. H. A. Newman has been elected a fellow of St. John's College.

It is proposed that the sum of 3030*l.* bequeathed to the University by Mrs. Amy Price Read, shall be devoted to the establishment of a research scholarship similar to the Allen scholarship. In the years when the Allen scholarship is confined to literary subjects of study the Amy Price Read scholarship is to be confined to scientific subjects and vice versa. The scholarship would be open to women students who have been admitted to the titles of degrees on the same terms as to graduates of the University.

LONDON.—The degree of *Ph.D. in Science* has been conferred on Fanny Lowater (Imperial College—Royal College of Science) for a thesis entitled "A Study of the Band Spectrum of Titanium Oxide."

THE use of wireless for university extension work has progressed rapidly in America. Of fifty-seven universities and colleges possessing broadcasting stations at least two—the University of Michigan and Michigan Agricultural College—have organised regular radio extension courses, and the National Radio Chamber of Commerce is developing a plan for establishing other similar courses.

THE Council of Armstrong College, Newcastle-on-Tyne, has appointed Prof. A. S. Ferguson, Ontario, to the chair of philosophy rendered vacant by the departure of Prof. R. F. A. Hoernlé to the University of the Witwatersrand, Johannesburg. Prof. Ferguson is a student of St. Andrews and Oxford, and has contributed articles on Plato to various periodicals.

THE directors of the Leplay House educational visits abroad are taking a group of their members, and others who care to join, to Spain for the Christmas vacation, leaving London December 22, and returning January 6, or with extension January 13. Modern social, economic, and political problems will be touched upon both from the point of view of the peasant life and the city life of to-day. A course of lectures will be included in the programme. Full particulars can be obtained from Miss Margaret Tatton, Leplay House, 65 Belgrave Road, Westminster, S.W.1.

A DEPARTMENT of Geology, Mining, and Metallurgy has been established by the Benares Hindu University under the direction of Prof. N. P. Gandhi. This development was made possible by a gift of Rs. 200,000 by the Maharaja of Jodhpur, who has also endowed a Jodhpur-Hardinge chair of technology. At present the staff of the department comprises two professors—of mining and metallurgy and of geology—an assistant professor of assaying and two demonstrators.

Two travelling fellowships open to women graduates of Great Britain, each of the value of 1000 dollars, are being offered through the British Federation of University Women, 92 Victoria Street, S.W.1. One is offered by the American University Women, to enable the holder to carry on a year's research in any foreign country she may choose. The other, the Rose Sidgwick Memorial fellowship, also endowed by the Americans, offers the same amount to enable a British woman graduate to carry on a year's research or advanced work at an American university, the choice of the university being left to the holder.

IN an article on the Rhodes Scholarships in the *Empire Review* for October, Mr. Ian D. Colvin celebrates the "coming of age" of the great scheme founded in 1902. He remarks that it is yet too young for us to judge of its fruits, as scholars have not yet had time to reach maturity and make their name in the world: he accordingly confines himself to an appreciation of the character of the founder and his aims in founding the scholarships, and a description of the administration of the trust. President Frank Aydelotte, of Swarthmore College, the American Secretary to the Rhodes trustees, is less cautious, having attempted in "Oxford of To-day" an estimate of the influence exerted by the American Rhodes scholars. In the first place he points out that they have, almost to a man, returned to America, and there is a consensus of opinion that they go back better Americans for their Oxford experience. Only one of them has become a British subject. More than a third of them are engaged in educational work, and of these many are already college professors, deans, and presidents. "Perhaps there is no career in the United States at the present time which represents more accurately what Rhodes thought of as public life, no career which offers a better opportunity to influence public opinion than that of professor or administrative officer in one of our American colleges or universities." One of them is United States Commissioner of Education, and as head of the Washington Bureau undoubtedly exercises very great influence. No account such as President Aydelotte has given for the Americans seems to have been published regarding the careers after leaving Oxford of the other Rhodes scholars. It is known, however, that an occupational census of those who were elected to scholarships up to 1916 gave the following percentages: educational work 32, law 25, business and industry 11, administration and other government service 8, medicine 7, ministers of religion 4, farming 3, social and philanthropic work 1½, journalism and publishing 1½, engineering and mining 1½, other occupations 5.

Societies and Academies.

LONDON.

Royal Society, November 8.—A. S. **Parkes**: Studies on the sex-ratio and related phenomena—fœtal retrogression in mice. By means of *corpora lutea* counts it was found that in mice the average amount of fœtal mortality leading to retrogression was 10·8 per 100 normal fœtuses. Daniel and King have shown for mice and rats respectively that the does may become pregnant at the œstrus period which follows within twenty-four hours after parturition, and that the gestation period of the second litter is prolonged in some cases as much as ten days. This abnormal prolongation of the embryonic stages, which is due to inhibited implantation in the uterine *mucosa*, can be used experimentally to determine the effect of unusually adverse conditions upon embryonic and fœtal mortality. Where the previous young were suckled less than six days, the amount of mortality rose to 17·6 per 100 normal fœtuses, while in prolonged gestations resulting from continued suckling of previous young, the amount of mortality was further increased to 23·1. The sex-ratio of young born in these two classes was respectively 80·4 and 62·1 males per 100 females. Since the normal sex-ratio of mice is not far from equality, this inverse correlation between the amount of fœtal mortality and the sex-ratio of the surviving fœtuses suggests that mortality during gestation falls preponderatingly upon the males.—R. A. **Fisher**: The influence of rainfall on the yield of wheat. The Rothamsted data for rainfall and wheat yields extend to 1854; these data have been utilised to calculate the average effect on the yield of rain at different periods of the harvest year, for plots under 13 different manurial treatments. An extension of the method of partial correlation, applicable when the number of independent variates is very large and can be arranged in a continuous series, is used. The several plots show marked differences in their response to rain, showing that it is not impossible for the farmer to adapt his manurial treatment to a wet or dry season. A large part of the differences may be ascribed to the effects of loss of soil nitrates by percolation; other effects not susceptible to this explanation, and not hitherto anticipated, include the losses on the highly nitrogenous plots due to late summer rain. The residual value of artificial nitrogenous manures appears from these results to be considerably greater than has been thought.—D. **Thursby-Pelham**: The placentation of *Hyrax Capensis*. The early development of Hyrax is unknown, but there is no embedding of the blastocyst which undergoes its development in the uterine lumen. The maternal epithelium is destroyed early by the trophoblast on all sides. The trophoblast is differentiated into two cytotrophoblastic layers:—(1) basal phagocytic layer (basal trophoblast); (2) cellular network enclosing lacunæ of maternal blood (inner trophoblast). The placentation throws little light on the affinities of Hyrax. While it agrees with the placenta of rodents in being hæmochorial, it differs in its zonary form and the detailed character of its trophoblast. Superficially it bears some resemblance to the placenta of Elephas in zonary arrangement and great complexity of allantoic villi, but in Hyrax there is no syncytial layer of maternal tissue surrounding the villi as in Elephas. Our present knowledge of the placentation of Hyrax tends to emphasise the isolated position the order occupies among Eutheria.

Physical Society, October 26.—Dr. Alexander Russell in the chair.—S. H. **Piper** and E. N. **Grindley**: The fine structure of some sodium salts of the fatty acids in soap curds. X-ray photographs of certain sodium salts of the fatty acids (soap curds) show lines due to reflections from planes with very wide spacings of the order 40 Å.U. These planar spacings increase uniformly with the number of CH_2 groups in the molecule, indicating an effective length of 1·25 Å.U. for the CH_2 group. These and other lines can be accounted for by assuming that the curds are in the smectic state described by Friedel.—E. A. **Owen** and G. D. **Preston**: X-ray analysis of solid solutions. The atomic structure of solid solutions of copper-aluminium, aluminium-magnesium, and copper-nickel has been examined by the X-ray spectrometer. In each case it was found that the solute atom replaces an atom in the lattice of the solvent, the substitution being accompanied by a distortion of the lattice. The eutectic alloy of aluminium and copper consists of a mixture of two distinct substances with different space lattices, one being $CuAl_2$ and the other a substance the space lattice of which cannot be distinguished from that of pure aluminium. The intermetallic compound $CuAl_2$ possesses a simple tetragonal lattice of side 4·28 Å.U. and axial ratio 0·562, the copper atoms being at the corners and the aluminium atoms at the centres of the four small faces. The atomic structure of the compound CuAl resembles that of a solid solution of aluminium in copper, but the distortion is considerably greater. The material has a face centred trigonal lattice of side 3·89 Å.U. and an angle between the axes of 94·6°, the 111 planes being composed alternately of aluminium and copper atoms.—H. **Chatley**: Cohesion. The consequences are discussed of assuming that the alternately positive and negative atoms in a crystal may be treated as doublets attracting according to an inverse fourth-power law, while the electron fields surrounding the atomic nuclei repel according to an inverse tenth-power law. The numerical results agree fairly well with the facts as regards the strain which produces rupture in solids, and as regards the rate of change of compressibility with compression in liquids.

Linnean Society, November 1.—Dr. A. B. Rendle, president, in the chair.—S. **Garside**: The forms of *Hypoxis stellata*, Linn. f., a South African species of Amaryllidaceæ. Four varieties are distinguished, one of these as yet undescribed. In each case the varieties have constant vegetative characters, but the flowers show a considerable range of colour variation of a "continuous" kind. Important cytological characters of the upper epidermis of the perianth lobes were described, with particular reference to the remarkable iridescent areas which occur in some varieties. Habitat may considerably influence the size of the plant, but the varietal characters remain constant.—H. A. **Baylis**: The host-distribution of parasitic thread-worms (nematodes). The nematodes parasitic in vertebrates show great variety in the extent to which they are limited to particular hosts. They may be divided broadly into a section with more or less strict "specificity" and a section with members occurring in various hosts, often of quite distantly related groups. Many of the latter have an intermediate host (commonly an invertebrate) during their earlier phases, and these forms, being introduced into the final host at a more advanced stage than those which have a direct development, may be better able to adapt themselves to a variety of final hosts. Among forms with a direct development, those which show the strictest specificity are probably the most specialised, this being often correlated with specialisation, in habits

or otherwise, of the hosts, while those which have a wide range have retained a primitive adaptability.—W. N. **Edwards**: On the cuticular structure of the Devonian plant Psilophyton. Specimens of *Psilophyton princeps*, Dawson, from Gaspé (New Brunswick) in which the cuticle is preserved, show that as in the early land plants of the Rhynie Chert the stem is provided with stomata. These resemble in size and distribution the stomata of Asteroxylon but have cuticle thickenings. No stomata were seen on the highly cuticularised spines, but these spines do not resemble intumescences of Rhynia, and Psilophyton is probably nearer to Asteroxylon.

Aristotelian Society, November 5.—Prof. T. Percy Nunn, president, in the chair.—T. P. **Nunn**: (Presidential address) Scientific objects and common-sense things. The greatest achievement of the physical sciences is generally held to be the discovery, behind the veil of common-sense things and observable events, of a world of scientific objects and unobservable events. The primary qualities of common-sense things are transferred without difficulty to scientific objects. Size, mass, and motion, for example, belong to an electron in the same sense in which they belong to a flying bullet or to a planet. Their materiality being thus assumed, these objects have constantly increased their hold upon the scientific mind. The philosophical question involved in this concept is whether objects can exist which only possess the primary qualities of common-sense things and have none of their secondary qualities. To resolve this problem we must have a satisfactory theory of the common-sense thing. Such a theory is that a thing is a structure embracing and actually consisting of all the sense-data which common-sense regards as qualities of the thing and are presented to any percipient at any time or place. Unless this doctrine is hopelessly wrong, the pretension that scientific objects are the reality of which the common-sense world is but the appearance, must be entirely abandoned. The real achievement of science is not to have disclosed any reality behind the veil of sensible things, but to have greatly extended and deepened and rationalised the scheme of the world revealed in perception.

IPSWICH.

Prehistoric Society of East Anglia (Autumn London meeting), October 10.—H. **Bury** (Presidential address): The distribution of palæoliths in the Hampshire basin, with special reference to a "palæolithic horizon" separating levels at which implements are common from those in which they are extremely rare. This horizon indicates the highest altitude reached by the rivers in palæolithic times; the implements found at higher levels were buried during glacial conditions, when the normal drainage was temporarily obliterated. The differences in the level of the horizon in the Hampshire, Thames, and Somme Basins respectively (150 to 130 feet) are due to changes in the position of the river mouths, and not to local warpings of the earth's crust. There is clear evidence from the New Forest and Bournemouth Plateaux that the river fell and rose again in Lower Palæolithic times, the total range of movement (100 feet) agreeing exactly with the change from the third to the first terrace of the Somme, which Commont attributes to the Chellean period. But the English evidence makes it clear that the subsequent rise of the river (in or after Acheulean times) was much higher than Commont admits, and reached the extreme level of the Palæolithic horizon. The corresponding sea-level is more difficult to ascertain, but evidence from the Isle of Wight points to 120 feet O.D.—M. C. **Burkitt**: The discovery in northern Spain of an industry which appears to be transitional between those of the late palæolithic and the opening of the neolithic ages. Masses of shells cemented to the roofs of certain caves on the coast of the Asturias are accompanied by a stone hand-pick made from a flat pebble fluted to a point, the butt and under side being unworked. This implement is found with the accompanying shell middens to overlay deposits containing the typical harpoons of the Azilian industry, and is evidently earlier than the early neolithic stage.—L. **Armstrong**: The excavations undertaken at Grimes' Graves, Norfolk, during the past summer. A survey of the site was made in 1922 to ascertain the level at which the floor-stone flint worked by the prehistoric miners outcropped in the adjoining valley. This season, aided by a grant from the Percy Sladen Memorial Trust, excavations were made with the view of determining whether a phase of mining could be traced on the hill slope earlier than the large galleried pits sunk from the top of the adjoining hill. A type of flint mine was discovered in which the radiating galleries were absent; descent was made by aid of rough steps left in the chalk; these were excavated by small hand-picks of splintered bone, which in one case was human. No trace of these pits can be detected on the surface; they are filled with an extremely compact deposit of chalk. Thus they are in direct contrast to the conditions in the long-known pits of Grimes' Graves, which seems to indicate a more ancient period of working. A glacial disturbance of the sides of the valley has thrust up a series of blocks of the flint towards the surface, which would probably attract the attention of the flint hunters.—A. G. **Wade**: Ancient flint-mines at Stoke Down, Sussex (*v.* NATURE, October 20, p. 597).

PARIS.

Academy of Sciences, October 22.—M. Albin Haller in the chair.—H. **Deslandres**: An equatorial of a new type, named the table equatorial, intended especially for researches in physical astronomy.—A. **Châtelet**: The properties of finite Abelian groups.—A. **Bloch**: The paratactic circles and the cyclid of Dupin.—M. **Hadamard**: Remarks on the preceding communication.—Maurice **Gevrey**: Some properties of quasi-analytical functions of one or more variables.—Harald **Bohr**: Nearly periodic functions.—G. **Valiron**: The theorem of Picard-Borel.—A. **Guillet**: The synchronisation of circular movements.—M. **Huguenard**: A method for the absolute measurement of the velocity of a current of air. This method utilises a novel principle. During the passage of an electric spark in air, in addition to the sound-wave, a little cloud of warm air is formed which can be rendered visible by means of a second spark placed on the axis of the first. If the air is moving, this cloud is carried along at the velocity of the air current and its position determined by eye for low velocities or photographically for high velocities. A diagram and description of the apparatus is given: it is not necessary to know the temperature or pressure of the gas nor the velocity of sound, and very high velocities can be readily measured by this method.—Marius **Pascal**: Observations on the note by M. P. Noaillon on "Superficial circulation."—P. **Idrac**: The structure of sea winds and their utilisation for hovering flight. A summary of the results of experiments on the movements of air currents over the sea, carried out during the autumn at the lighthouse of Jument d'Ouessant.—Alex. **Véronnet**: The evolution of the trajectory of a star in a resistant medium.

—W. W. **Heinrich**: The analytical prolongations of the limited problem.—Ladislas **Gorczinski**: The diminution of intensity in the red portion of the solar radiation, observed in Europe and at the equator. The measurements were made with bimetallic actinometers (Michelson system) furnished with coloured glasses. Between the equator and latitude 52° N. there is a progressive increase in the intensity of the red portion of the solar radiation as the distance from the equator increases.—P. **Lambert**, G. **Déjardin**, and D. **Chalonge**: An attempt to prove the existence, at high altitude, of a solar radiation in the extreme ultra-violet. Photographs of the solar spectrum were made with a specially designed spectrograph at the Vallot Observatory at the summit of Mt. Blanc, the experiments being specially directed to detect ultra-violet light between the wave lengths 1900 Å. and 2150 Å. The results were negative, no impression being shown by the plate after 40 minutes' exposure. It is suggested that oxygen may possess absorption bands in this region, and this point is to be the subject of further experiments.—F. **Wolfers**: The diffusion of the X-rays and Bragg's law. The work of Stenström, Siegbahn, Hjalmar, and Duane and Patterson has shown that Bragg's law, $\kappa\lambda = 2a \sin\alpha$ is not rigorously true, the angles measured in the higher orders being a little too small. The author shows that it is possible to explain these deviations in a manner compatible with the quanta theory, assuming only that diffusion in a crystal of any substance is of the same nature. The deviations calculated from the theory thus developed are compared with the measurements of Hjalmar.—E. **Darmois** and J. **Périn**: Cryoscopy in $Na_2SO_4 . 10H_2O$. The molecular magnitude of the malates, molybdates, and molybdomalates. Cryscopic measurements show that these complex molybdic acids are all derived from two molecules of malic acid.—Paul **Pascal**: The constitution and evolution of the metallic oxides and hydroxides. Magnetic analysis serves to distinguish water of hydration from water of constitution. Applications of the method to the cases of cadmium hydroxide, magnesium hydroxide, and zinc hydroxide are given in detail.—P. **Brenans** and C. **Prost**: The *p*-iodoxybenzoic acids. Description of the preparation of the iodo- derivatives of para-oxybenzoic acid, $C_6H_3I(OH)(CO.OH)$ (3:4:1) and C_6H_2I2 (OH)(CO.OH) (3,5 : 4 : 1).—E. **Kohn-Abrest** and J. **Ricardoni**: A new method of estimating hydrocyanic acid in cyanogenetic plants. The hydrocyanic acid is removed from the cold solution by means of a current of air passed for a period of eight hours.—A. **Baldit**: The trajectories of storms and their splitting up into two.—Marc **Bridel** and Pierre **Delauney**: The properties of loroglossin and its products of hydrolysis: glucose and loroglossigenine. Loroglossin, under the action of emulsin, gives glucose and a new substance, loroglossigenine. The latter has been obtained in the crystalline form, but in a quantity too small for complete analysis.—C. **Fromageot**: The influence of the concentration of salts in sea water on the assimilation of green Algae. The intensity of the photosynthesis varies appreciably with the concentration of the medium. There is an optimum saline concentration for the photosynthesis, and this concentration is precisely that of sea water.—F. W. T. **Hunger**: The nature of the cocoanut pearl and its formation.—Georges **Claude**: The transformation of ammonia into fertiliser.—J. **Athanasiu**: The nervous motive energy of the heart and the nature of the contraction of the myocardium.—Charles **Benoit** and André **Helbronner**: The antagonism of radiations. Physiological and therapeutic consequences. In the field of physiology, the effect of irradiation by ultra-violet light is increased both in intensity and rapidity by a preliminary infra-red irradiation. On the other hand, the effects tend to be neutralised by a subsequent infra-red irradiation.—Jacques **Pellegrin**: A new apodal fish from the Bay of California, and its biology.—J. **Legendre**: The zoophilia of certain mosquitoes and its application to prophylaxy. In some regions *Culex pipiens* and *Anopheles maculipennis* both attack man, but it has been noted that at a coast station in Brittany, where these species are present together, neither attacks man. It is suggested that one of these insects might be used to suppress the other, and an experiment in this direction has been started.—A. **Vandel**: The existence and conditions of parthenogenesis in a terrestrial Isopod: *Trichoniscus* (*Spiloniscus*) *provisorius*.—A. **Desgrez**, H. **Bierry**, and F. **Rathery**: The utility of vitamin B and of levulose in the cure by insulin. The transitory effect of insulin in diabetes may be increased and prolonged by a suitable food regime. The addition of either vitamin B or levulose, or a mixture of both, allows the insulin injections to be made at longer intervals and thus increases the useful effect of a given amount of this substance.—Mme. J. Samuel **Lattès**: The corpuscular nature of the radiation responsible for the phenomenon of necrosis (produced by the X-rays) and on the best thickness of the filters.—M. **Sluys**: The creation of multiple foci of the secondary β-radiation in the middle of the tissues for a therapeutic purpose.—Charles **Richet** and Jean **Célice**: Local sera therapy in acute infantile gastro-enteritis.

SYDNEY.

Linnean Society of New South Wales, August 29.—Mr. A. F. Basset Hull, president, in the chair.—Vera **Irwin-Smith**: Studies in life-histories of Australian Diptera Brachycera. ii. Asilidæ. No. 1. Catalogue of the species of Asilidæ of which the earlier stages have been recorded. Asilidæ. No. 2. Notes on the egg-laying, eggs and young larvæ of *Neoaratus hercules* Wied. Larvæ were hatched from eggs laid by a female in captivity. The eggs were 1·1-1·2 mm. long and 0·40-0·43 mm. broad, and the newly-hatched larvæ were 2·2-2·6 mm. long. The eggs are distinguished by a characteristic pattern in dark pigment on the inner layer of the shell.—J. **McLuckie**: Studies in symbiosis. v. A contribution to the physiology of *Gastrodia sesamoides* (R.Br.). An account of the mycorhiza and the bacteria associated with the rhizomes of the species, and their relation to the higher plant. The nutritive phase of the association of fungal hyphæ, bacteria and Orchid is also discussed.—J. M. **Petrie**: Studies in plant pigments. i. The yellow colouring-matter of the Acacias. Four different species of Acacia (*A. discolor*, *A. linifolia*, *A. decurrens* and *A. longifolia*) have been examined to ascertain the nature of the colouring matter of their yellow inflorescences. The water soluble yellow pigment was a glucoside of kæmpferol, which exists in the flowers as a rhamnose glucoside; no free flavonol was found. The Acacia tannins were composed of phloroglucinol, protocatechuic and gallic acids and deposited on hydrolysis large amounts of red phlobaphene anhydrides. The carotin and xanthophyll as plastid pigments were present in amounts from 0·14 to 0·3 per cent., and the flavonol about 0·06 per cent. of the fresh flowers.—E. W. **Ferguson**: Revision of the Amycterides (Coleoptera). Pt. viii. The Euomides. There is no single character separating this group from the remainder of the subfamily. All the described species are reviewed and in many cases redescribed from the types. The descriptions of ten new species and two new varieties are included.

Official Publications Received.

Department of the Interior: Bureau of Education. Bulletin, 1923, No. 31: Americanization in the United States. By Prof. John J. Mahoney. Pp. iv+42. (Washington: Government Printing Office.) 5 cents.

Year Book of the Royal Society of Tropical Medicine and Hygiene. Session 1923–24. Pp. 27+lv. (London: 11 Chandos Street, W.1.)

Publications of the American Astronomical Society. Vol. 4. Pp. iv+432+8 plates. (Madison, Wis.: Washburn Observatory.) 2 dollars.

The Parliament of the Commonwealth of Australia, 1923 (Second Session). Meteorological Service. Report to the Honorable the Minister for Home and Territories on the Work of the Meteorological Service for the Financial Year 1921–22. By H. A. Hunt. Pp. 31. (Melbourne: Albert J. Mullett.) 1s. 3d.

The Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. 53, January to June. Pp. 262. (London: 50 Great Russell Street, W.C.1.) 15s. net.

Ministry of Public Works, Egypt. Report on the Work of the Physical Department for the Year ending March 31st, 1923. By Dr. H. E. Hurst. Pp. 25. (Cairo: Government Publications Office.) P.T. 5.

Ministry of Public Works, Egypt. Zoological Service, Publication No. 36: Report on the Zoological Service for the Year 1922, in which is included the 24th Annual Report of the Giza Zoological Gardens. By Major S. S. Flower. Pp. 26. Zoological Service, Publication No. 37: List of Birds of Prey 1898–1923, with Notes on their Longevity. By Major S. S. Flower. Pp. 46. (Cairo: Government Publications Office.) P.T. 5 each.

Departement van Landbouw, Nijverheid en Handel. "'S Lands Plantentuin" ("Jardin Botanique de Buitenzorg"). Treubia: Receuil de Travaux Zoölogiques, Hydrobiologiques et Océanographiques. Vol. 4, Livraison 1-4: Meteorological and Hydrographical Observations made in the Western Part of the Netherlands East Indian Archipelago. By K. M. van Weel. Pp. 559+9 plates+28 charts. (Batavia: Drukkerijen Ruygrok & Co.)

Abstract-Bulletin of Nela Research Laboratory, National Lamp Works of General Electric Company, Cleveland, Ohio. Vol. 1, No. 3, October 1922. Pp. ix+303-521. (Cleveland, Ohio.)

Proceedings of the Liverpool Geological Society. Session the Sixty-fourth, 1922–1923. Part 4, Vol. 13. Edited by C. B. Travis. Pp. xviii+231-341. (Liverpool.)

The Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts. Year Book, 1923. Pp. 195. (Philadelphia.)

Edinburgh University and the East of Scotland College of Agriculture: Animal Breeding Research Department. Report of the Director for the Year ending 30th June 1923. Pp. 16. (Edinburgh.)

Diary of Societies.

SATURDAY, NOVEMBER 17.

BRITISH MYCOLOGICAL SOCIETY (in Botany Department, University College), at 11.—Miss R. Bracher: Observations on Rhytisma.—J. J. Clarke: Notes on some Mycological Chromidia.—W. J. Dowson: A Mould attacking Sweet Peas.—Dr. A. S. Horne and G. H. Jones: Further Contributions to the Study of Eidamia.—R. Paulson: Observations on Tree Mycorrhiza.—A. A. Pearson: A Foray in Paris.

BRITISH PSYCHOLOGICAL SOCIETY (General Meeting conjointly with the Æsthetic Section) (at King's College), at 3.15.—R. Fry: What Artists want from Psycho-Analysis.

MONDAY, NOVEMBER 19.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—A. B. Eason and others: Discussion on Power in Telephone Exchanges.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6.—Prof. T. P. Nunn: The Philosophy of Signor Gentile.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 7.—Special Exhibition of Industrial Kinematograph Films.

ROYAL INSTITUTE OF BRITISH ARCHITECTS (at 1 Wimpole Street), at 8.—G. T. Forrest: The Rebuilding of Ypres.

ROYAL SOCIETY OF ARTS, at 8.—S. H. Davies: The Cultivation of Cocoa in British Tropical Colonies.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Count Byron de Prorok: Results of Recent Research at Carthage.

TUESDAY, NOVEMBER 20.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—E. Gosse: Personal Relations between Medicine and Literature (David Lloyd Roberts Lecture).

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—The Secretary: (1) Report on the Additions to the Society's Menagerie during the month of October 1923; (2) Exhibition of a Collection of Autographs recently presented the Society by Mr. Hugh S. Gladstone.—W. E. Le Gros Clark: Notes on the Living Tarsier.—Dr. Francis, Baron Nopsca: Reversible and Irreversible Evolution; a Study based on Reptiles.—Dr. J. R. Garrood: Two Skeletons of the Cetacean *Pseudorca crassidens* from Thorney Fen, Cambridgeshire.—Dr. C. Crossland: Polychæta of Tropical East Africa, the Red Sea, and Cape Verde Islands; and of the Maldive Archipelago.—Miss Joan B. Procter: (1) New and Rare Reptiles from South America; (2) New and Rare Reptiles and Batrachians from the Australian Region.

INSTITUTION OF CIVIL ENGINEERS, at 6.—R. F. Grantham: The Effect of Groyning on Some Parts of the English Coast.—E. W. Hollingworth: The Tides from an Engineer's Standpoint.

INSTITUTE OF MARINE ENGINEERS, INC., at 6.30.—H. Campbell: The Gas Turbine.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Meeting organised by the Scientific and Technical Group.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—L. H. Dudley Buxton: The Inhabitants of Inner Mongolia.

CIRCLE OF SCIENTIFIC, TECHNICAL, AND TRADE JOURNALISTS, at 8.15.—Sir Richard Gregory: Progress in Science and Invention.

WEDNESDAY, NOVEMBER 21.

ROYAL SOCIETY OF MEDICINE, at 5.—General Meeting.

ROYAL METEOROLOGICAL SOCIETY, at 5.—L. F. Richardson: Attempts to measure Air Temperature by shooting Spheres upward.—Col. H. G. Lyons: Exhibit of a Replica of an Early Korean Raingauge.—F. J. W. Whipple: Exhibit of a Limit-gauge for Rainfall.—S. N. Sen: The Distribution of Air Density over the Globe.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. L. J. Wills: The Development of the Severn Valley in the Neighbourhood of Ironbridge and Bridgnorth.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.—H. H. Mardon: Address.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—Dr. E. V. Appleton and F. S. Thompson: Periodic Trigger Reception.—R. C. Clinker: A Dynamic Model of a Valve and Oscillating Circuit.

INSTITUTION OF PRODUCTION ENGINEERS (at Engineers' Club), at 7.30.—A. W. Swan: The Use of Charts in Engineering.

ROYAL MICROSCOPICAL SOCIETY, at 7.45.—F. R. Brambell: Sex-Reversal and Intersexuality.—Prof. J. Brontë Gatenby: Further Evidence on the Transition of Peritoneal Cells into Germ-Cells in Amphibia.—Dr. M. Johnston: The Preparation of Eel Scales for Microscopic Examination.—F. I. G. Rawlins: The Microscope in Physics.—Dr. H. M. Woodcock: Exhibition of Bacteriomorphic Granules (or Granules Simulating Bacteria) resulting from Cell-lysis or Digestion.

ROYAL SOCIETY OF ARTS, at 8.—A. Knowles: Forgeries of Ancient Stained Glass.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

THURSDAY, NOVEMBER 22.

MEDICO-PSYCHOLOGICAL ASSOCIATION OF GREAT BRITAIN AND IRELAND (at 11 Chandos Street, W.1), at 2.45.—Prof. D. C. Winckler: The Psychiatrical and Neurological Teaching at the Dutch Universities, especially at the University of Utrecht.

ROYAL SOCIETY, at 4.—Special General Meeting to consider the Annual Report of Council.—At 4.30.—F. Simeon: The Carbon Arc Spectrum in the Extreme Ultra-Violet, II.—H. J. Gough and Dr. D. Hanson: The Behaviour of Metals subjected to Repeated Stresses.—W. Sucksmith and L. F. Bates: A Null Method of Measuring the Gyro-Magnetic Ratio.—J. H. Shaxby: Studies in Brownian Movement, II. The Determination of Avogadro's Number from Observations on Bacteria (Cocci).—*To be read in title only*:—Dr. H. Hartridge and F. J. W. Roughton: The Kinetics of Hæmoglobin, II.—A. F. A. Young: The Thermionic and Photo-Electric Properties of the Electro-Positive Metals.—O. F. T. Roberts: The Theoretical Scattering of Smoke in a Turbulent Atmosphere.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. J. J. Findlay: Rhythm, Labour, and Child Development.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—A. Bachellery: The Electrification of the Midi Railway (Joint Meeting with the British Section of the Société des Ingénieurs Civils de France).

SOCIETY OF DYERS AND COLOURISTS (London Section) (at Dyers' Hall, Dowgate Hill, E.C.3), at 7.—A. D. Lang: Macbeth Artificial Daylight, and the Fade-ometer.

FRIDAY, NOVEMBER 23.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—F. Martin Duncan: Lantern Lecture.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—British Locomotive Practice and Performance.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—W. A. Tookey: Technical Arbitrations.

PUBLIC LECTURES.

SATURDAY, NOVEMBER 17.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—G. Morris: The Prehistoric Survey of Selborne.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—S. H. Warren: The Cave-Paintings of Stone Age Man in Europe.

MONDAY, NOVEMBER 19.

KING'S COLLEGE, LONDON, at 5.30.—Prof. W. T. Gordon: Gem Minerals and their Uses in Art and Industry (Swiney Lectures). (Succeeding Lectures on November 21, 23, 26, 28, 30, December 3, 5, 7, 10, 12, and 14.)

TUESDAY, NOVEMBER 20.

UNIVERSITY COLLEGE, at 5.30.—Engr.-Capt. E. C. Smith: Epochs in the History of Marine Engineering.

WEDNESDAY, NOVEMBER 21.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. C. W. Saleeby: Sunlight and Disease.

UNIVERSITY COLLEGE, at 5.30.—A. Jenkinson: Handwriting and Early Printing.

THURSDAY, NOVEMBER 22.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.15.—Dr. J. W. Heslop Harrison: Problems of Variation. (Succeeding Lecture on November 23.)

LONDON SCHOOL OF ECONOMICS, at 5.30.—F. S. Marvin: Great Britain and Europe (League of Nations Union Lecture).

FRIDAY, NOVEMBER 23.

KING'S COLLEGE, LONDON, at 5.30.—C. E. M. Joad: The Philosophical Background of Music and Poetry: (1) The Function of Art.

ROYAL SOCIETY OF ARTS, at 8.—Major H. Barnes: Hygiene and Architecture: Remedial Hygiene—Health and the Hospital (Chadwick Lecture).

SATURDAY, NOVEMBER 24.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss E. Goodyear: The Romance of the Highways.